November 1970

Smithsonian

Fire and spillage in the Gulf of Mexico.
The interests of conservation and the consumers of oil *(p. 18)*

For four generations
we've been making medicines
as if people's lives depended on them.
Lilly
ELI LILLY AND COMPANY, INDIANAPOLIS

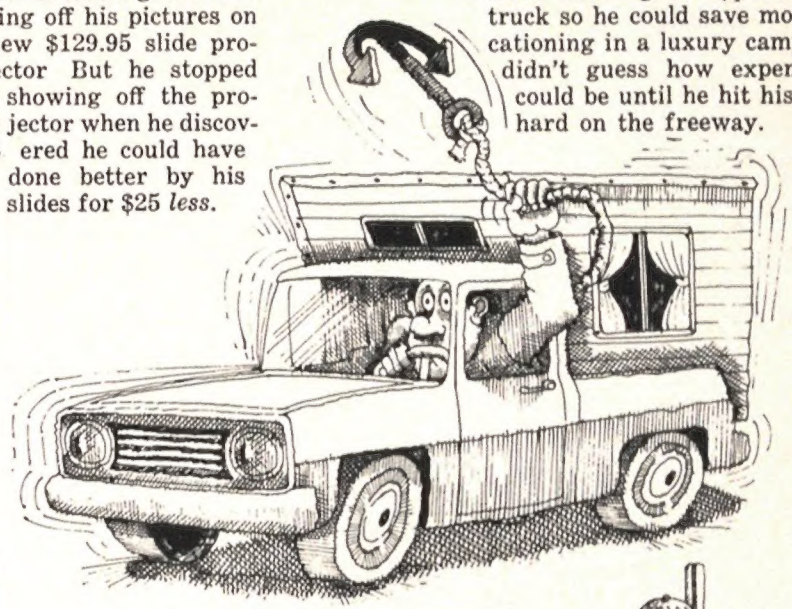
Ten little losers, standing in a line. One bought our magazine. Then there were nine.

When Ann A.'s new $129.95 food waste disposer kept jamming on bones and refused to chew up grapefruit-rind halves, she wanted to kick the manufacturer. But when she found out she could have bought a disposal that *would* dispose of such things for only $112, she wanted to kick herself.

Bill B. felt like a million in his $70 raincoat—until he needed a *snow*coat and realized he could have gotten a raincoat he liked *with* a zip-in alpaca lining for just $60.

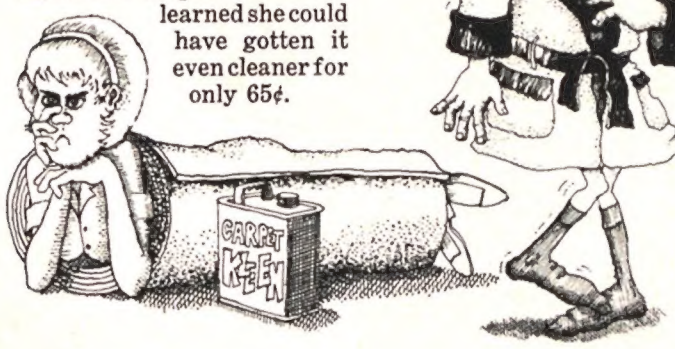
Charlie C. had a great time showing off his pictures on his new $129.95 slide projector But he stopped showing off the projector when he discovered he could have done better by his slides for $25 *less*.

Dave D. bought a ¾-ton pickup truck so he could save money vacationing in a luxury camper. He didn't guess how expensive it could be until he hit his brakes hard on the freeway.

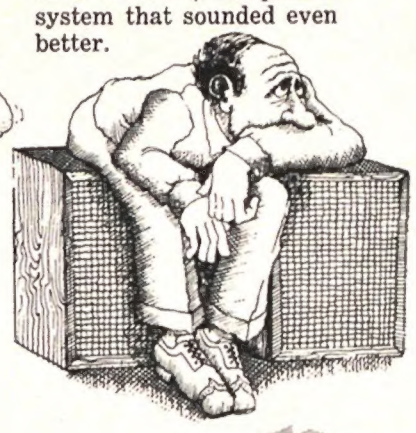


Frank F. loved the new $1.75 briefs his wife bought for his birthday . . . until they came out of the washer. If only she'd read *Consumer Reports*, she could have *kept* Frank happy and saved a lot of money.

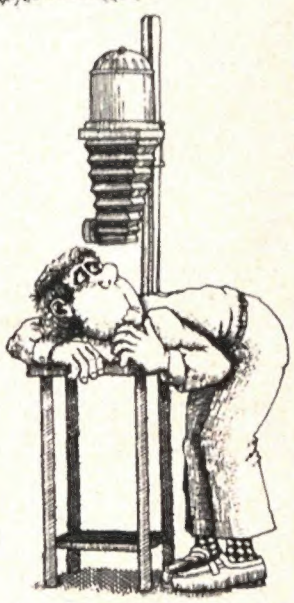
Edith E. thought she was really saving money when she cleaned her 9x12 rug herself for only $2.60. She felt like a Home Ec. dropout when she learned she could have gotten it even cleaner for only 65¢.



The crowning touch on George G.'s stereo system was a pair of $250 loudspeakers. Nobody told him that the same manufacturer made a $128 speaker system that sounded even better.



Harry H. wanted to invest in the best when he repainted the bathroom. But by the time he learned that the best cost 70¢ *less* a quart than what he'd paid, the gloss had begun to dull.



Irving I. really felt like a pro with his new $174.50 enlarger. When he started pricing *lenses* for it, he wept all over his darkroom for not knowing about a higher rated model he *could* have bought for $135 *complete*.

Johnny J. made up his mind that he'd never again spend his hard-earned money on power mowers with poorly-shielded blades, circular saws that jammed, caulking compounds that shrank and cracked, antenna amplifiers that didn't improve his TV picture, convertible sofas his wife couldn't open, clothes dryers that snagged the laundry, boats that capsized if they took on too much water, and products that just weren't worth the price.

He subscribed to CONSUMER REPORTS.

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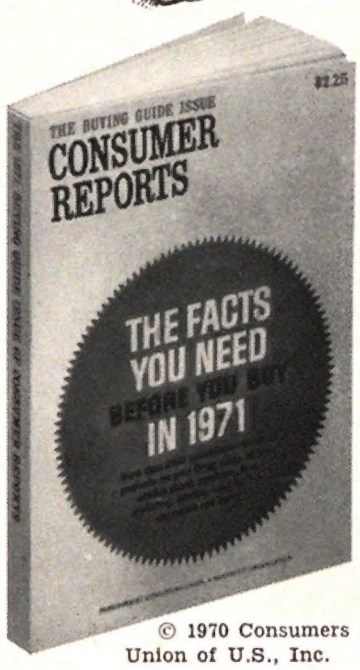

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November 1970

Smithsonian

Volume 1, Number 8

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Secretary Ripley's comments

The view from the castle

The National Collection of Fine Arts now dwells in marble halls, further proof that Washington has become an art center

The study of art has been, at least in intent, a component of the Smithsonian since its founding. The Act of Establishment of 1846 called for an art gallery where works would be "arranged in such order, and so classed, as best [to] facilitate the examination and study of them," and the original plans for the first building did include such a room.

But the earliest collections were largely destroyed in a fire that gutted the top floor of the "Castle" building in 1865, and for many years thereafter art lay dormant at the Smithsonian. Eventually, with the death in 1903 of Harriet Lane Johnston, President Buchanan's niece, the question was posed: *Did* the nation have a national art collection? Mrs. Johnston had left her collection of paintings to a "national art gallery," provided there was one. It appeared that the original collections had established a satisfactory precedent, and in 1906 the Institution's art collections were designated the National Gallery of Art.

Poorly housed and indifferently shown in the Museum of Natural History, they still attracted gifts, even though over the years the Smithsonian had seemed little prepared to sponsor the study of art. Then in 1937 Andrew Mellon made his magnificent gift of old master paintings and sculpture to the nation. After considerable debate in Congress, it was agreed to transfer the title "National Gallery" to the Mellon collection, while the older collection of the Smithsonian was renamed the National Collection of Fine Arts. Its relation to the Mellon gallery was to be roughly that of the Luxembourg to the Louvre. It was to encourage, among other things, the development of *native* American arts and crafts, was to help set up a national study and archival center, and was intended to represent the United States in international art matters.

A new building on the Mall was to be built for the National Collection with government funds. There was even an architectural competition for the building, won by Eero Saarinen with a contemporary design that would have been extraordinarily pioneering for Washington in the 1940s. Perhaps too extraordinary, for nothing happened.

But the vision of its potential role was kept alive by David Finley, then director of the new National Gallery of Art, and by Leonard Carmichael, seventh Secretary of the Smithsonian, who encouraged the search for an available building. Under President Eisenhower, the old U.S. Patent Office, one of the finest Greek Revival buildings in the nation, was preserved from the wreckers and turned over to the Smithsonian for purposes of displaying art.

The imagination of Carmichael and Finley has been amply justified. The National Collection, at home in the lofty halls and imposing vistas of the reconstituted Patent Office Building, has found a fitting home. Here its collections, opened to the public in May 1968, can be seen for the first time in appropriate splendor. Now with the fortunate addition of the Archives of American Art, which moved its collection of materials to the building in 1970, there is for the first time in the Smithsonian's history a genuine opportunity to encourage the development and study of American art.

S. Dillon Ripley

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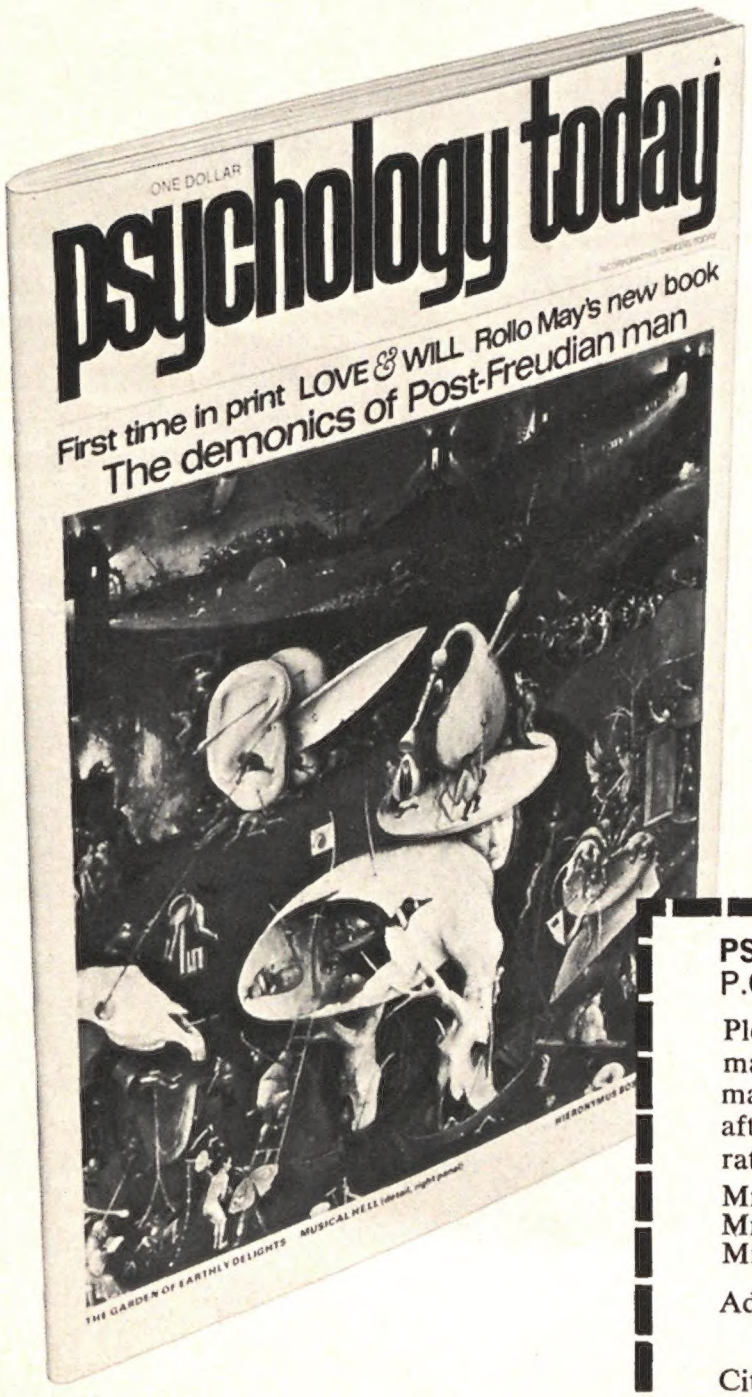
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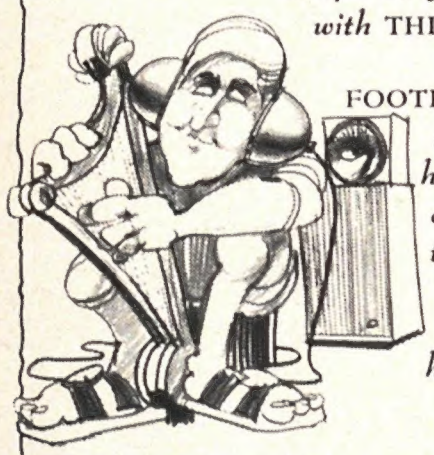
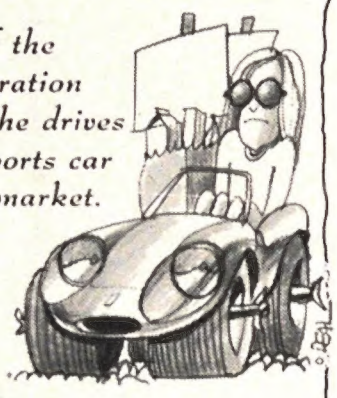
She wears sneakers for deep sea diving. Her social life consists of computer dating. She plays MONAD* *on every date. Should she marry the first guy she wins a game from?*

He's a quadraphonic stereo buff. He composes hard rock on his harp. He grooves with THINKING MAN'S FOOTBALL.* *Should he work a quarterback sneak into his new ballet?*



She's part of the women's liberation movement. She drives an Italian sports car to the meat market. She's an expert at ACQUIRE.* *So how can she acquire an Italian sport?*



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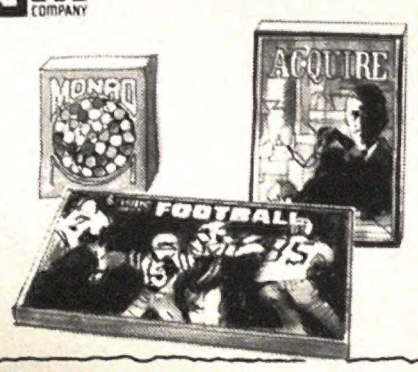

Letters to the Editor

London cleanup

Dear Sir: After reading the article about London's great cleanup, I became very angry. Is it going to take killer smogs and putrid rivers in America before we wake up? What can I as an 18-year-old do?

NANCY CHURCH

Southfield, Michigan

Dear Sir: Gould's enthusiastic statements regarding sulfuric acid, generated from fossil fuel after it leaves those wonderful 800-foot stacks might be contested by the Swedish and Finnish people.

BENJAMIN LEVADIE

Barre, Vermont

Pure sulfuric acid is not falling on Sweden and Finland but they have been measuring a higher than normal acid content in rain. Ed.

Dear Sir: Your article on London is fascinating with its world of information and subtle humor, and the pictures are superb. Who knows, we may be able to save the world yet.

MRS. DONALD A. HARRIS

San Carlos, California

Buying spotted furs

Dear Sir: I was deeply shocked by the stupidity and ignorance of Gina Lollobrigida's statement (SMITHSONIAN, September 1970) that "It's not I who hunts" in defense of her enormous wardrobe of spotted animal skins. Doesn't Miss Lollobrigida realize that, with the large price tag for each hide, she is supporting the continued destruction of these magnificent creatures and financing the ruthless butchery by poachers?

DANA GUMB JR.

McLean, Virginia

Dear Sir: Perhaps your article about conservation gaining against the fashion world was premature. Since the Mason Act has been declared unconstitutional in New York state, furriers may buy hides of animals threatened with extinction.

ALIDA PELLEGRINI

River Vale, New Jersey

The Mason Act was passed, then declared unconstitutional by a lower court. In September it came before the Court of Appeals. Ed.

Book reviews

Dear Sir: The only adverse comment I have is the book review by Scott Hart on the late Herbert Hoover. Hart's reference to "Herbert Hoover's bland bleating" and "President whose mind was as stiff as his chin-choking collar" are statements that ill grace your magazine. I suggest that you retain reviewers long on objectivity and short on insults.

RICHARD H. TUTTLE

Eden, North Carolina

When SMITHSONIAN *assigns a critic in whose ability and taste it has faith we do not dictate what he should say. Criticism is just that, even if some readers—and sometimes the magazine—do not agree.* Ed.

The language

Dear Sir: Your headlong rush to be with it, as exemplified by the mod slang in your September headlines, is depressing.

A carefully written article by Dr. John F. Eisenberg is rewarded by "A gaudy predator does its thing . . ." and K.C. Tessendorf's interesting ballooning article is tagged with "Let's hear it. . . ."

Let's hear it for the English language, which is just as much of an endangered species as the Ceylonese leopard.

MARTIN GROSS

New York City

Both the headlines cited use words which we feel have been accepted. Fowler (Modern English Usage) and Mencken (The American Language) would have approved. We are glad the headlines did not prevent Mr. Gross from reading the articles. We do respect the language and SMITHSONIAN *is at least grammatical enough not to confuse "such as" and "as" with "like".* Ed.

(Continued on page 8)

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(Continued from page 6)

Whistler

Dear Sir: In the article on Whistler's Peacock Room the author says that "Queen Victoria's sister, Louise, dropped by. . . ." Queen Victoria had only a half brother and a half sister (whose name was not Louise); however, she did have a daughter named Louise who, in 1876, would have been just about the right age to be amused by the antics of James Whistler.

KATHERINE C. LITTLE
Aberdeen, Maryland

Mrs. Little is correct. It was Victoria's daughter, then 28. We do not know whether she was amused, but it is a safe bet her mother would not have been. Ed.

Blaine society

Dear Sir: I have the distinct impression that all the members of the Oregon state police force are members of the James G. Blaine Society. While traveling through the state recently my foreign license plates caused me to be fined for exceeding the speed limit. The other cars with which I had been traveling must have belonged to local boys for they went merrily on their way at 70 m.p.h. This is one way to discourage tourism.

EDGAR T. CAMPBELL, M.D.
Hagerstown, Maryland

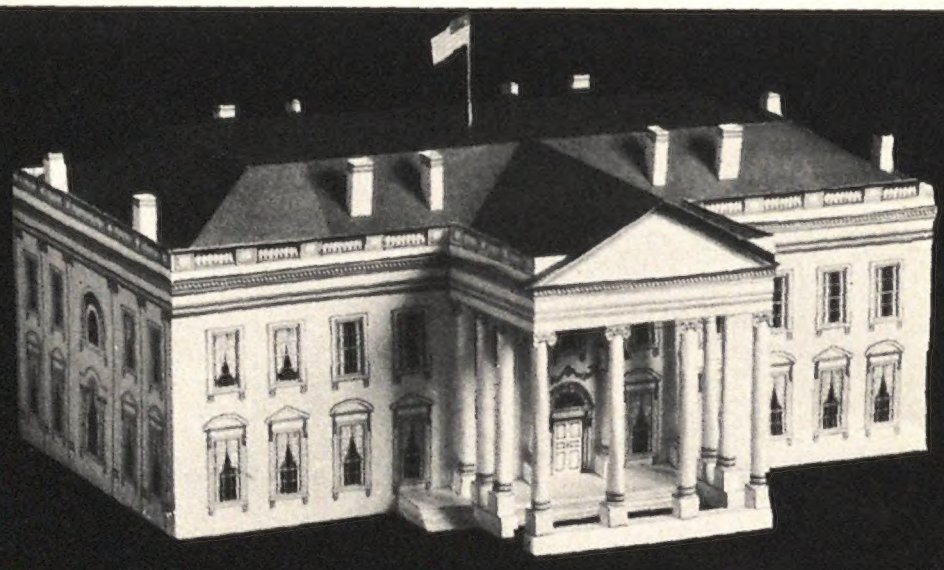
Dear Sir: Stewart Holbrook would be appalled to see any article extolling the virtues of the state of Oregon in any magazine with a circulation of more than a dozen or so.

It is not hard to see your true purpose: You are attempting to convince all those lousy foreigners to come to Oregon by implying that it isn't such an awful place after all.

ROBERT SHORT
Portland, Oregon

Dear Sir: I'm trying to get some Blaine Society stickers. I am a resident of South Hampton, New Hampshire, a town so small that its post office is in a neighboring state. Southern New Hampshire, while not as spectacular as Oregon, is a beautiful place to live—you know what I'm getting at.

RICHARD H. MILLER
Amesbury, Massachusetts



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The Koerners aren't trying to save the world. Just a little piece of it.

Romero is a small farm village clinging to the mountains of Colombia, South America. Poverty is extreme. Illiteracy is almost total. Electricity, sanitary facilities and running water are nowhere to be seen, and small children haul water from the river three miles away. There is a school in the district, but convincing parents that education should take precedence over water-hauling is a hard argument to win.

The Fuentes are one of the village families. Poor even by Romero's sub-standards. The mud-brick house with dirt floors they live in isn't even theirs. The two-acre farm behind it provides all the income for the family of nine. Most of the time there isn't enough to go around. Yet, this has been a good year for the Fuentes. Their 7-year-old daughter Luz Marina has been able to stay in school.

This miraculous stroke of luck is because of a family living in New York, who are helping Luz Marina. They're the Koerners. Through Save The Children Federation, they are contributing $15.00 a month to help.

For Richard and Marianne Koerner the $15.00 a month is not an extreme sacrifice. Yet, with three robust boys of their own, there are many ways they could use the money. But Richard, whose job involves foreign travel, doesn't have to imagine the poverty the Fuentes endure. He's seen it. He knows, too, that Save The Children can do a remarkable number of things with the money.

First, Luz Marina's immediate school needs are taken care of. Secondly, funds are available to the family to carry out their self-help plan to raise hens. The eggs will help improve the family diet and increase the family income. Finally, a small portion of the Koerner's contribution, together with money from other sponsors, has been lent to the villagers. With their own hands and sweat, they're building a water storage tank and a pipeline. Hopefully, the new water supply will increase the crop yield and the village's income so that some day they will no longer need help.

Self-help. That's what Save The Children Federation is all about. Although contributions are tax-deductible as a charity, the aim is not merely to buy a child a few hot meals, a new coat, or shoes. Instead, your contribution is used to give people the boost they need to start helping themselves.

Sponsors are desperately needed for children in Korea, Vietnam, Latin America, Africa, Greece, the Middle East, as well as Appalachian and American Indian children. You can select the child's nationality and will receive a photo, regular progress reports and a chance to correspond and visit.

Richard Koerner hopes that one day, one of his business trips will enable him to meet the Fuentes. Many sponsors do visit their children, and tell us that it is one of the most gratifying experiences of their lives.

The Koerners know they can't save the world for $15 a month. Just a small corner of it. But, maybe that is the way to save the world. If there are enough people like the Koerners. How about you?

National Sponsors (partial list):
Faith Baldwin, Hon. James A. Farley, Gene Kelly, Mrs. Eli Lilly, Paul Newman, Mrs. J. C. Penney, Frank Sinatra.

Save The Children Federation, founded in 1932, is registered with the U.S. State Department Advisory Committee on Voluntary Foreign Aid.

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By Al Capp

I remember Rube, the Chaplin of the funny pages

A tribute to the one and only Goldberg, he of the many inventions, by his cantankerous colleague from Dogpatch

In the early '30s Rube Goldberg was to the young comic artist what Chaplin was to the young comic then and earlier; he was the Master, at the peak of his powers. But to newspaper publishers Goldberg had become a problem. The problem wasn't that he didn't continue to be funny. He was funnier than ever. It was that publishers were no longer sure that readers wanted fun on the funny pages. As we entered the '30s a new element had entered the funnies: misery. And it was going well.

A stunted and sanctimonious little orphan named Annie, a mirthless accident-prone detective named Dick and a Cro-Magnon named Joe whose daily adventures didn't end as Goldberg's did, in creating hilarity, but in creating anxiety, were worrying millions of newspaper readers into rushing out, day after day, to buy the papers that carried them. And a hell of a lot of good that did them. The next day matters of course would get worse, and the next day, and the next, but readers never learned. Every poll and survey proved that misery sold more papers than merriment, and publishers began asking themselves if Rube Goldberg's cartoons were worth the space they occupied and the money they cost, merely to make people feel fine, when it was clearly better business to make them feel frustrated and frenzied.

This new element on the funny page was called "suspense." I was in my early 20s then, working for one of the new "suspense" strippers as an assistant. I wrote, drew and hand-delivered the strip for $22.50 a week while he blew thousands a week trying with no success to make an impression on a new movie-cutie pie, Marlene Dietrich. I still think of him. He is dead now. I never thought of him then as a comic artist, nor do I remember him as one now so much as a salesman of cheap thrills and maudlin sentimentality.

Back then, though, they were household words. Back then, remember, the comic strip was the TV soap-opera series of its time. Comic strips were as inevitable and as necessary in the lives of most Americans as "Laugh In" and "Bonanza" are today, and their creators were as celebrated and beloved as their stars. None however was as celebrated and beloved as Rube Goldberg. He was not only our greatest cartoonist, he was our greatest after-dinner speaker (and he still is); he was big, handsome, radiant and rich, he exuded good-nature, good humor and goodwill and so the man I worked for—"Mr. Cheap and Maudlin"—hated his guts.

This was why: Rube and my boss were under contract to the same syndicate (an agency that sold and

Rube Goldberg demonstrates his own invention–a life-sized portrait-maker—as part of a comprehensive display of his work at the Smithsonian's Museum of History and Technology, starting November 24. He sits on a pneumatic cushion (A), forcing air through a tube (B) which moves forward an ice boat (C) armed with a lighted cigar (D). This bursts a balloon (E), convincing a jittery dictator (F) that he's been shot. He falls backward on a bulb (G) which snaps the picture.
The resulting portrait appears on page 14.

distributed newspaper features to newspapers for a percentage of the take, over and above the basic guarantee). The syndicate's guarantee to Goldberg was opulent, one of the highest in the field, and it had been in effect for many years with one or two to go. Yet, practically, it amounted to little more than a gentlemanly understanding. Goldberg's cartoons over the years had earned comfortable sums over and above the guarantee shared by the syndicate and Goldberg.

But the new "suspense" strips were already cutting into Goldberg's list of newspapers, and there was no telling how far the trend would go. At the time I'm writing of, it was generally known that the syndicate was making every effort to persuade my boss to renew his contract, and he was demanding an even more opulent guarantee than Goldberg's, for a longer time, a guarantee of more sales effort on his cartoons.

It was an illuminating time for me. Raw and undernourished though I was, I was importantly involved in as dramatic a transition period in my profession as the shift from silents to talkies was in films. My heart

Assured a full measure of fame for his cartoon creation, hard-muscled, soft-headed Li'l Abner, who appears in some 1,200 papers, Al Capp deplores the sad turn in comics from fun to maudlin misery and suspense.

was with the comedy of Rube Goldberg, yet for that $22.50 a week I was devoting my gifts to the sort of "suspense" strip that was inexorably ousting him from paper after paper. If I describe my gifts at the time as considerable I'm not being immodest. I'm giving the Kid I was then his due. A year later I was doing "Li'l Abner." It was considered, from the beginning, as seductive a "suspense" strip as there was and funny enough to be referred to in *Time* as in the "tradition of such great masters as Rube Goldberg."

Although I was on the winning side, I hated to see Goldberg's side lose. The side of laughter and irony and wit. It seemed to me that he could survive and prosper again, if he would combine comedy with the new element of suspense, if he'd change from pure comedy to comic melodrama.

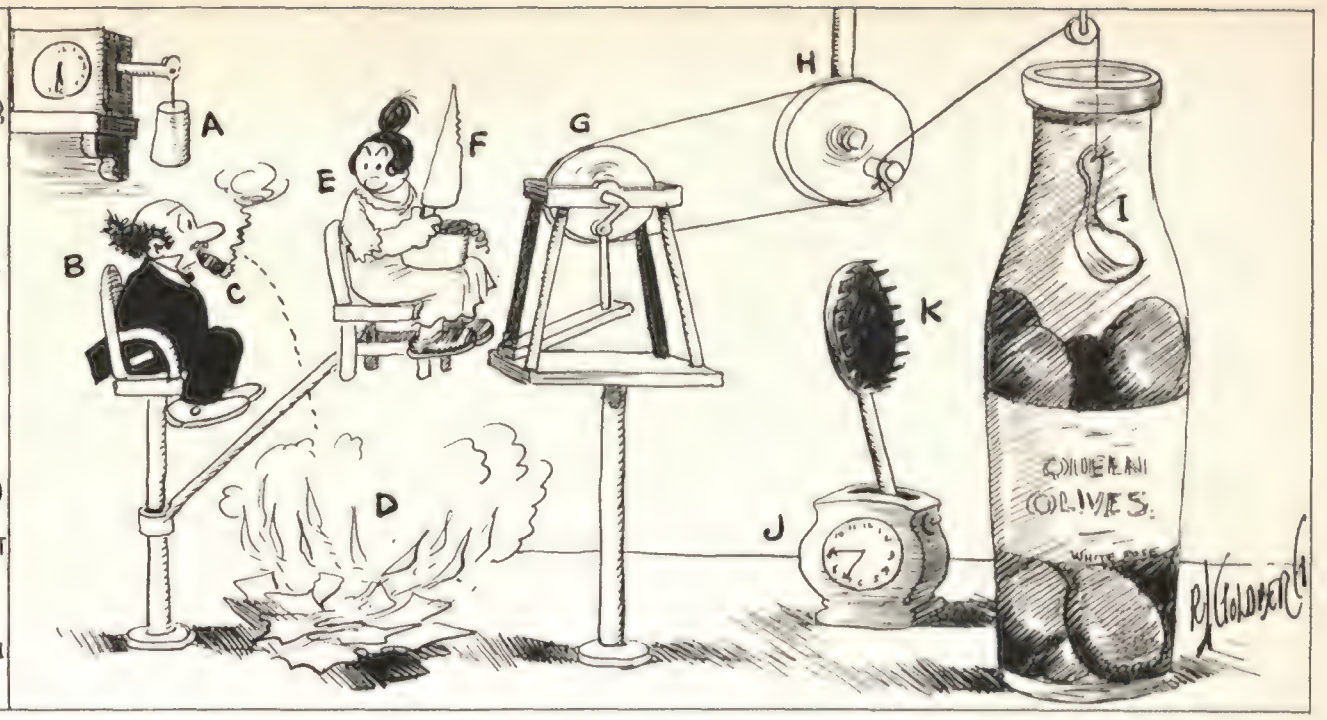
Then one day I saw by the papers that Goldberg had changed. But alas, beyond recognition. Suddenly, in the last year of his contract, in what was clearly a last, frantic effort, "Mike and Ike," "Boob McNutt," "Life's Little Jokes" and the stunningly sensible "Inventions" vanished and "Doc Wright" appeared. The Doc was a Lincolnesque character—selfless, heroic, kindly, philosophical; in short, an asphyxiating bore. He reeked with the sanctimoniousness Goldberg had always ridiculed.

Goldberg trying to become a mirthless maudlin "suspense" cartoonist was as hopeless as Bernard Shaw trying to become Lawrence Welk. He didn't have the talentlessness for it. I was convinced that "Doc Wright" (and Rube Goldberg) would indeed vanish if I didn't save them. This was comparable to the Republic of Chad being convinced that Red China would be vanquished unless it saved her.

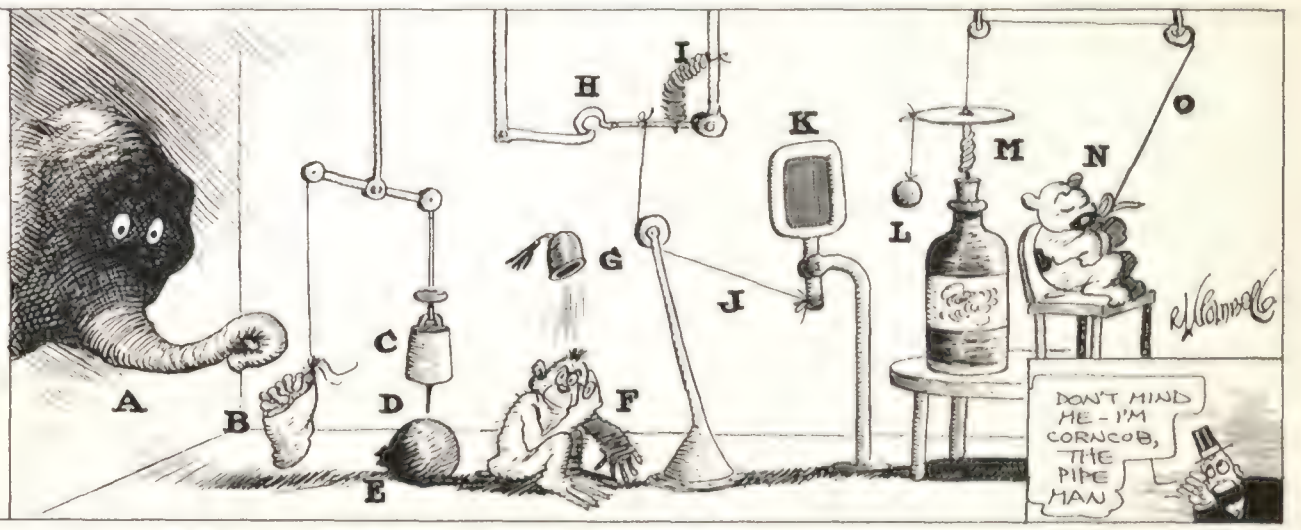
He agreed to see me because he remembered me as the Kid he'd met at my boss' studio, whose job was cleaning up the strips. When company came, my boss'

Rube's alarm clock, a model displayed at the Smithsonian, is activated by a 6 a.m. garbage man. He lifts an ash can, causing mule to kick statue of Indian warrior, whose arrow punctures an ice bucket. Ice cubes fall on false teeth, making them chatter and nip elephant's tail. He raises his trunk in pain, pressing lever that starts toy maestro leading quartet in a sad song. Sentimental girl's tears water flowers which grow and tickle man's feet. His laughter triggers gong and slides the sleeper into slippers on wheels—and thus into a cold shower. Four more Goldberg cartoons appear opposite.

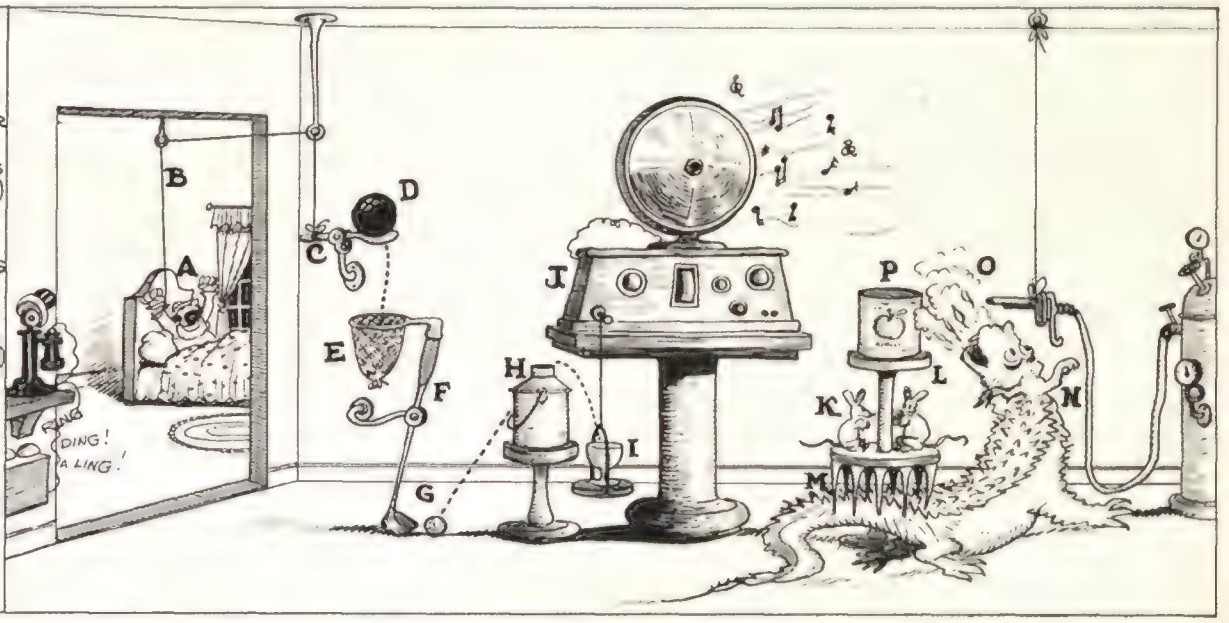
AT 6:30 WEIGHT (A) AUTOMATICALLY DROPS ON HEAD OF DWARF (B), CAUSING HIM TO YELL AND DROP CIGAR (C), WHICH SETS FIRE TO PAPER (D) - HEAT FROM FIRE ANGERS DWARF'S WIFE (E) - SHE SHARPEN'S POTATO KNIFE (F) ON GRINDSTONE (G) WHICH TURNS WHEEL (H) CAUSING OLIVE SPOON (I) TO DIP REPEATEDLY INTO OLIVES - IF SPOON DOES NOT LIFT AN OLIVE IN 15 MINUTES, CLOCK (J) AUTOMATICALLY PUSHES GLASS-CUTTER (K) AGAINST BOTTLE AND TAKES OUT CHUNK OF GLASS BIG ENOUGH FOR YOU TO STICK YOUR FINGER IN AND PULL OUT AN OLIVE.



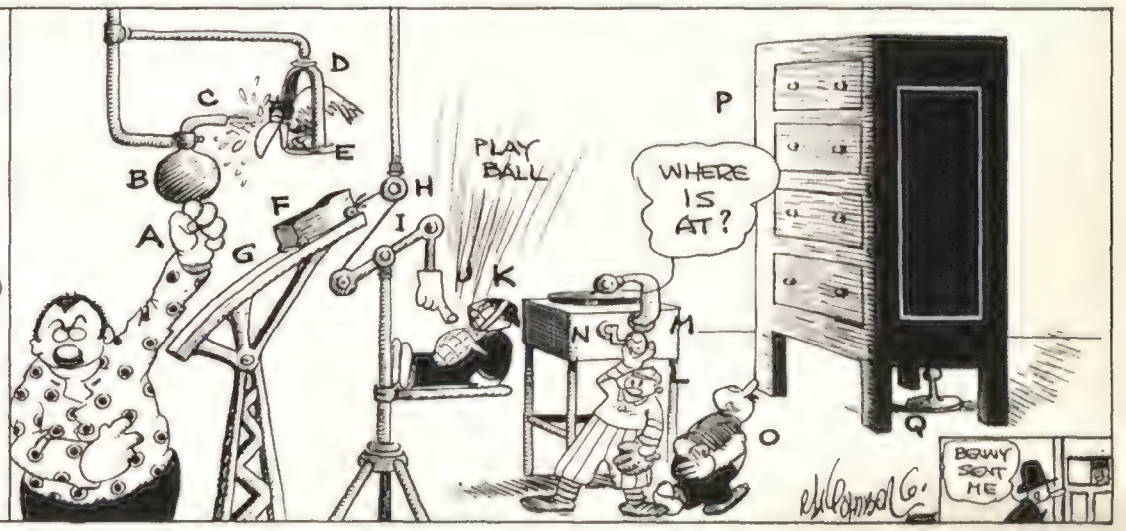
ELEPHANT (A) EATS PEANUTS (B) - AS BAG GETS LIGHTER WEIGHT (C) DROPS AND SPIKE (D) PUNCTURES BALLOON (E) - EXPLOSION SCARES MONKEY (F) - HIS HAT (G) FLIES OFF AND RELEASES HOOK (H), CAUSING SPRING (I) TO PULL STRING (J), WHICH TILTS TENNIS RACKET (K) - RACKET HITS BALL (L), MAKING IT SPIN AROUND ON ATTACHED STRING, THEREBY SCREWING CORKSCREW INTO CORK (M) - BALL HITS SLEEPING DOG (N) WHO JUMPS AND PULLS CORK OUT OF BOTTLE WITH STRING (O) - MY, HOW SIMPLE!



PROFESSOR BUTTS FALLS ON HIS HEAD AND DOPES OUT A SIMPLIFIED CAN-OPENER WHILE HE IS STILL GROGGY. GO OUTSIDE AND CALL UP YOUR HOME. WHEN PHONE BELL RINGS, MAID (A) MISTAKES IT FOR AN ALARM CLOCK - SHE AWAKENS AND STRETCHES, PULLING CORD (B) WHICH RAISES END OF LADLE (C). BALL (D) DROPS INTO NET (E) CAUSING GOLF CLUB (F) TO SWING AGAINST BALL (G), MAKING A CLEAN DRIVE AND UPSETTING MILK CAN (H). MILK SPILLS INTO GLASS (I) AND THE WEIGHT PULLS SWITCH ON RADIO (J). WALTZING MICE (K) HEARING MUSIC AND PROCEED TO DANCE, CAUSING REVOLVING APPARATUS (L) TO SPIN AND TURN. SPIKES (M) SCRATCH TAIL OF PET DRAGON (N) WHO IN ANGER EMITS FIRE IGNITING ACETYLENE TORCH (O) AND BURNING OFF TOP OF TOMATO CAN (P) AS IT ROTATES. WHEN NOT OPENING CANS, THE DRAGON CAN ALWAYS BE KEPT BUSY CHASING AWAY INCOME TAX INVESTIGATORS AND PROHIBITION OFFICERS.



WHEN YOU FIND YOU'VE LOST YOUR COLLAR BUTTON AGAIN, YOU WAVE ARMS IN ANGER-FIST (A) PRESSES BULB (B) AND SQUIRTS WATER (C) INTO EYE OF YIFFIK BIRD (D) - BIRD IS TEMPORARILY BLINDED & WALKS OFF PERCH (E), FALLING INTO CAR (F) OF SCENIC RAILWAY (G) - CAR DESCENDS, CAUSING CORD (H) TO TILT BAR (I) - WOODEN FINGER (J) PRESSES REFEREE DOLL (K) MAKING IT SAY "PLAY BALL" - PITCHER (L) OF MIDGET GIANTS GRABS BALL (M) WHICH IS ATTACHED TO HANDLE OF PHONOGRAPH (N) AND WINDS UP - PHONOGRAPH RECORD ASKS, "WHERE IS AT?" - PHILOSOPHER FATHER (O) OF PITCHER, WHO IS EVEN SMALLER THAN HIS SON, IS PUZZLED OVER QUESTION AND WALKS AROUND TRYING TO FIGURE IT OUT - HE IS SO ABSORBED IN PROBLEM, HE WALKS UNDER BUREAU (P) AND BUMPS INTO COLLAR BUTTON (Q), YELLING "OUCH" AND SHOWING YOU WHERE COLLAR BUTTON IS.



orders were for me to stop writing or drawing, pick up an eraser, rub, and not do anything else, until they left. The '30s were a time when it was thought to be as suicidal for a cartoonist to admit that he had an assistant as for a movie idol to admit that he had a wife.

Rube's studio was elegant, orderly and decorated with pictures by other great men and pictures of Rube with other great men. I remember that when I was shown in, he was on the phone, talking to his syndicate about a request from some city in the Midwest, a two-day journey by train, for a personal appearance on some important public occasion. He grunted and asked if it would help Doc Wright with the local paper. The answer must have been that nothing would help Doc Wright because Rube grunted again and said something like to hell with it.

I began by saying that I thought he was the funniest cartoonist in the world and that the world still wanted fun and that, although it *was* true that "suspense" suddenly sold more papers than fun, I was convinced that the public still wanted to laugh and that if he *combined* his comedy with the new "suspense," "Doc Wright" could sell more papers than anything.

Rube said he'd think it over and to call him back in a few days. I did. He said he thought he'd better work it out himself. I was left with a theory.

And so, instead of working it out with Rube Goldberg in "Doc Wright" in my spare time, I worked it out alone. I combined the fun I'd learned to love in Goldberg's cartoons, with "suspense," and that combination of farce and melodrama made "Li'l Abner."

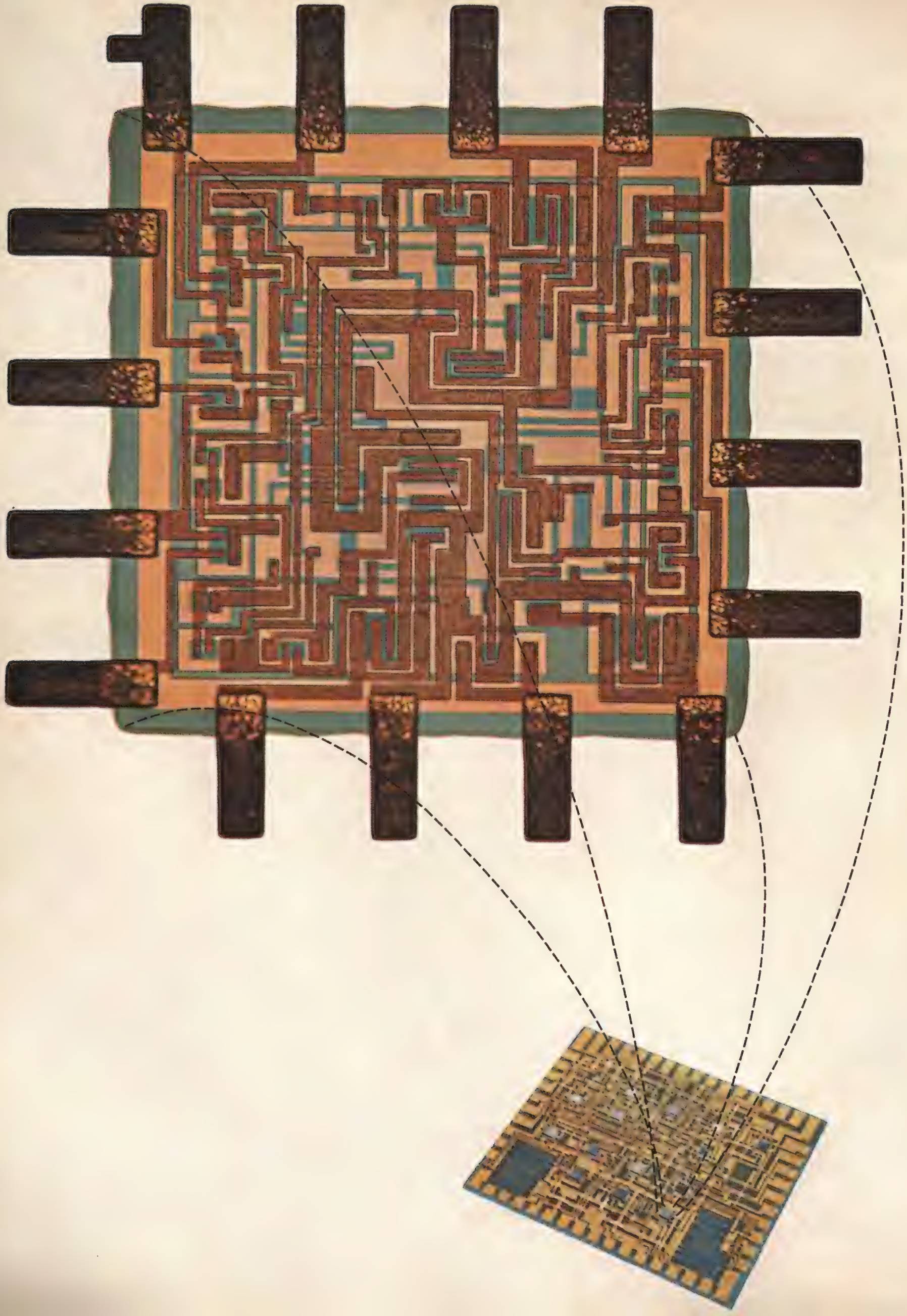
Is this, then, a story that ends by proving the Kid was right, and the Master was wrong? No. That isn't the end of the story. It's a long story—it goes on from the '30s to the '70s, and it ends by proving that the best the Kid could do was adjust to a temporary (40-year) situation, but that the Master had been right from the beginning, and that his only mistake was deigning to adjust to a passing (40-year) fad that deserved only his contempt.

"Doc Wright" vanished from the comic page, and Rube switched to the editorial page. In 1948, he won the Pulitzer Prize. In 1964, he left the editorial page and switched to sculpture (opposite page). If there was a Hogarth prize for sculpture, he'd win it today, at 87.

His greatest victory, however, is over all the suspense cartoonists, the pollsters, the publishers who claimed that Goldberg's day—the day of pure fun—was over. The tormented orphan, with her Afro hairstyle and her Orval Faubus life-style survives. The dauntless Dick and the uneducable hillbilly, too. But the others are all pure Goldberg: "Beetle Bailey" although he is a WASP; "B.C." is pure Goldberg, although a bit less lusty; "Peanuts" is pure Goldberg, although a bit diluted; Feiffer's cartoons are "Life's Little Jokes" all over again, although they pretend not to be by use of bits of New Left slogans and jargon popular in Brooklyn Heights psychiatric circles; "Pogo" now is pure Goldberg, the only one that is frequently every bit as good.

The grandsons of "Boob McNutt" have overcome.

Self-portrait of the artist at his present age, 87, was snapped by his invention (pages 10 & 11). Author of many books, Rube recently gained new prestige as a sculptor. Opposite: a bust of himself.



Circuits and synergy

To fill a variety of communications needs, Bell Labs and Western Electric have worked together to develop a special kind of integrated circuit. Based on two compatible and complementary technologies—silicon and tantalum—this "hybrid integrated circuit" is hundreds of times smaller and more reliable than circuits using discrete solid-state components.

The silicon portions of the circuit contain active components such as diodes and transistors; some low-precision resistors and the necessary interconnections are also formed on the tiny silicon chips. Hundreds of these chips are fabricated on one silicon slice. Tiny gold conductors—"beam leads"—are formed on each chip at the same time. Then the chips are separated and the beam leads bonded to tantalum thin-film circuits. Typically no more than one or two square inches, tantalum circuits contain precision resistors, capacitors, and interconnections etched into the metal film, previously deposited on glass or ceramic substrates.

Hybrid integrated circuits open new opportunities for circuit designers in many areas of communications systems engineering—telephone equipment, transmission, switching.

In this hybrid integration technology, design and manufacturing are intimately related. Designer and maker must work closely together. The Bell System fosters this concerted action—this synergy—with Bell Labs, for research and development, and Western Electric for manufacturing and supply. At several plants Bell Labs and Western Electric engineers work together in Process Capability Laboratories, speeding new designs into manufacture.

Here are a few examples of their teamwork.

The tantalum portion of a hybrid circuit starts as a 2000-Angstrom layer of tantalum, deposited on glass or ceramic. This process, invented at Bell Labs, was first carried out in a vacuum under bell jars. Western Electric designed and built "open ended" machines. Now, deposition takes place as the glass or ceramic chips move through the machine on a chain.

For highest precision, newly formed tantalum thin-film resistors require adjustment. This is done by removing, electrochemically, just the right amount of tantalum to raise the resistance to the required value. Bell Labs devised the process; Western Electric computerized and automated it.

Silicon circuits are sensitive to impurities such as sodium ions in the air. So, they used to be sealed into expensive evacuated cans. But now, a gold and silicon-nitride shield gives the required protection at low cost. Originated by Bell Labs, it was put to work by Western Electric.

Making connections to integrated circuits once called for individual attachment of fine gold wires. Then Bell Labs came up with "beam leads": gold conductors plated into place on silicon circuits. In addition to being conductors, the leads also give mechanical support. Western Electric developed methods for bonding them to circuits.

Beam leads are fabricated as part of the silicon circuit but their free ends must be attached to other circuitry. Bell Labs and Western Electric have developed thermocompression bonding techniques for this job. With the proper combination of time, temperature, and pressure all leads on the silicon circuit are bonded simultaneously to a thin-film circuit.

In the future, we hope to get more circuitry into less space and to find new functions for the technology. The circuit shown here, for instance, is one of some 200 logic "building blocks" for use in private branch exchanges, data sets, and other customer telephone equipment. It could not have been built with "discrete-component" technology. And we will not stop with silicon and tantalum. For other jobs, other materials may be better. Bell Labs and Western Electric are working together to find and apply them.

Bell Labs
Western Electric

Undersea gusher causes "chocolate mousse" effect as oil burbles around Santa Barbara's ill-famed Platform "A" after its blowout in January 1969.

By Warren R. Young

Possible solutions to oil spillage, a growing problem

Can we stop this pollution at its source or clean it up? The only alternative would be a non-petroleum economy

"Time and the ocean, and some fostering star, in high cabal have made us what we are."

The thought of an inborn link between human fates and the majestic waters of the planet evoked poetic imagery more than scientific concern when Sir William Watson set down these words early in the century. Today, our bond to the sea has a frightening, though confusing, reality.

We sprang from the ocean, wise men believe, we and all life. Evolution and eons transpired, as living things thrived in the pure energy of sun and rain and air and each other. Some left their legacy beneath the earth—a rich and potent treasure we call oil. This, more than anything else, powers a lavish world ruled by modern man. But now the ocean, like a long-forgiving parent, is asking questions about our careless ways.

The alarm over oil spills has been spreading among conservationists ever since the morning of March 18, 1967. That was when the tanker *Torrey Canyon,* burrowing heavily through the English Channel waters, with her hull-bending load of sulphurous Kuwait crude, blundered onto the Seven Stones Reef a dozen miles off the southwestern tip of England. As the heavy liquid oozed from the ruptured vessel, the stage was set for a discouraging drama.

Aware that a black tide from the *Torrey Canyon* could ruin their holiday resorts near Land's End in Cornwall, the British urgently but pragmatically set about defending their beaches. Mobilizing men, vessels and aircraft almost as if reenacting the miracle of Dunkirk, they relied primarily on two seemingly straightforward means of counterattack. They dumped into the water and on the shores two-and-a-half-million gallons of chemicals intended to disperse the oil slick into the expanse of ocean. They also set about firebombing the wreck, expecting to burn what oil she still held.

Instead of disappearing, much of the oil turned into a brown emulsion resembling chocolate mousse—too stable to go away. And while the *Torrey Canyon* was set afire several times, her cargo refused to burn efficiently. The lighter, more volatile range of the petroleum had already evaporated, and seawater kept the hull too cool for the remainder to burn.

After bombardment with 80 tons of high explosives, 3,000 gallons of napalm, 10,000 gallons of jet fuel and several rockets, the broken hull sank to the bottom, with nobody able to say conclusively whether she was still carrying some oil. Thousands of troops ultimately scrubbed and burned the beaches back to acceptable appearance.

The underlying mistake the British made in their attempt to limit the disaster was to assume that a simple, head-on response would solve a delicate, complex situation. Opponents and defenders of the oil industry, politicians, naturalists, scientists and engineers have all been guilty of similar oversimplification when they assess and combat the problem of oil spills. The result, for everybody, has been a mounting tangle of confusion.

Some alarmed nature-lovers, fearing that the earth's tunic of living organisms will come totally unraveled, propose that man learn to live once again without petroleum. Irate citizens in Santa Barbara have formed organizations like GOO, Inc. (for Get Oil Out) to urge a local ban on offshore oil drilling in their own areas. Some industry spokesmen, on the other hand, while agreeing that fouled beaches and dead birds are regrettable, regard most of the public outcry as an interference with their handling of their own problems. Accustomed to wresting spoils from nature, oilmen regard a few spills as a reasonable price for progress.

After the Interior Department issued regulations seeking a written report to the Coast Guard on the amount, rate, time, date and circumstances of every visible evidence of oil in U.S. waters, a technical magazine said in an editorial: "We feel that this will be a wasteful activity, not helping at all to reduce oil spills, but merely adding to the paper pollution that is nearly strangling us. In a country with

Warren R. Young is a free-lance writer who was formerly the science editor of Life. *He has a forthcoming book on Santa Barbara.*

American tanker *Torrey Canyon* lies with broken back on England's Seven Stones Reef after spewing cargo.

thousands of miles of coastline, millions of cars and boats, to document every minor oil spill just doesn't make sense. . . ." The editorial also asserted that it will be professional industry men, if anybody, who will discover the answers—"certainly not a bunch of 'paper merchants' from Hickel's hideaway."

Must we forget our 20th-century romance with oil? Or will the ocean solve its own sticky problems? Neither extreme view is prudent or practical. Dr. Thomas A. Murphy of the Federal Water Quality Administration (FWQA) Laboratory, in Edison, N.J., recently put it this way: "Oil pollution is a very complex phenomenon. I would propose today that while it is not about to create a global disaster in the near future, neither is it a tolerable nuisance. It is very likely a problem of major impact on our environment, an impact of a more pervasive and disturbing nature than the obvious effects on the birds and the beaches. The reason we have not realized this until recently is that we have not been looking for the right things."

Among popular misconceptions about oil spills is the notion that they are a new phenomenon. But in 1907, the largest schooner ever built, the seven-masted *Thomas W. Lawson,* set out on her maiden voyage with a reported two million gallons of crude oil. She was promptly wrecked upon the same Scilly Isles the *Torrey Canyon* later tried to skirt. Her oil cargo devastated a nearby colony of 100,000 puffins, quaintly attractive bright-billed seabirds.

During World War II vessels carrying some five to ten million tons of oil were sunk, damage unknown. In the three years preceding the *Torrey Canyon* grounding, there were 39 officially reported tanker accidents with oil spilled.

The *Torrey Canyon* held 119,000 tons of oil, and most of it went into the water. Since then the public has been made aware of several other major oil mishaps. There was the breakup of the tanker *Ocean Eagle* in San Juan Bay in 1968, the drilling blowout on Platform "A" and related seepage in the Santa Barbara Channel in 1969 and the runaway fire and subsequent gusher on Platform Charlie off Louisiana (see cover) in 1970. Yet all the large spills combined

are only a small fraction of all the oil that gets into the sea. An estimated 7,500 oil-pollution incidents, large and small, occur annually, including oil still being washed from some tankers that empty their ballast water at sea despite international agreements. In all, ships and oil rigs put a million tons of oil into the ocean every year. More millions of tons presumably find their way there from service station drains, the residue from evaporated gasoline and oil-based solvents from other sources. This pollution adds up to approximately 40 times the combined effect of the *Torrey Canyon, Ocean Eagle,* Santa Barbara and Breton Sound disasters.

Oil leaks occur in nature. Santa Barbara led to studies of natural seepage, and Alan A. Allen and Roger Schlueter of General Research Corporation measured it in 1969. At Coal Oil Point near Santa Barbara, they found 50 to 70 barrels of oil leaking daily. No wonder Indians used to waterproof their canoes with the natural pitch they found along the shore here. And the amount of natural seepage throughout the world, apart from tankers and undersea drilling, is undetermined.

With all this loss of oil it is small wonder that gooey lumps of weathered tar are now found in mid-ocean, as Thor Heyerdahl noted on his papyrus boat voyage.

Power depends on oil

A full three-quarters of all the power consumed by our civilization comes from oil and its sister petroleum resource, natural gas. "What many of the anti-oil people fail to realize," one petroleum industry spokesman complains with justice, "is that when you shut down an oil well, you are probably shutting down a power plant." Unless a great many more of our rivers are to be dammed for hydroelectric power or many more nuclear plants are built, petroleum use could not be drastically reduced even in theory.

Oil itself has been misunderstood since it was first given the name "petroleum"—a direct contraction of the Latin for "rock oil." Yet petroleum is not an inorganic mineral at all, but the transmuted remains of prehistoric living organisms. Nor is it a single chemical substance; crude oils contain hundreds of hydrocarbon compounds plus, usually, minor but important constituents such as sulphur and nitrogen. Crude oils also differ radically from each other, and therefore vary in their effect on the environment. Some, with little sulphur, are called "sweet crudes"; those with the most sulphur are "sour." The image of crude oil as a bluish-black substance that floats but will not mix with water is not reliable either. It might fit one type of crude to a degree, but the next might range from almost colorless to black, usually appearing

"Surf's up" at Santa Barbara. Waves crash in a sickly surge of oil and water. They strike the breakwater, blackening the rocks and sending thick globs flying.

A beach cleaning crew at Santa Barbara gathers oil-soaked straw and spreads a fresh layer. Tractor (below) packs sand and tar-blackened straw into a dike to hold back more oily waves.

greenish or brownish. Some crudes weigh only 80 percent as much as water; others are almost heavy enough to sink. Many hydrocarbons found in oil do indeed dissolve in varying degrees in water.

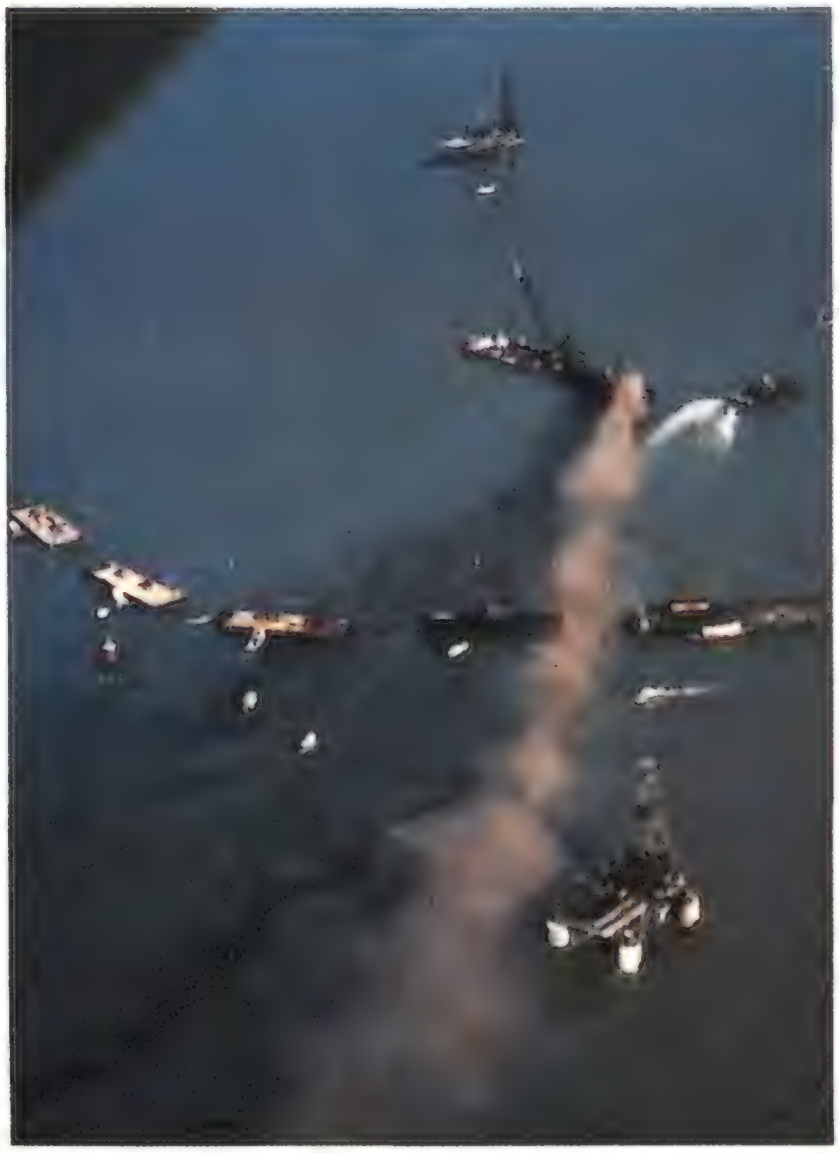
Some crude oils boil away almost completely below 500 degrees F.; others barely begin to distill at that temperature.

When actually let loose in the sea, crudes take on a number of physical forms and combinations. Some portions evaporate, leaving a constantly changing mix behind. Thin layers on the surface may be broken by wave action, then folded together and formed into roughly parallel streaks of ropelike tar. Under certain conditions the sea may whip up a bizarre array of emulsions: oil-in-water (like milk) or water-in-oil (like butter). The emulsions may be orange-brown, white or yellow; the most stable type, and therefore hardest to get rid of, is that regularly referred to as chocolate mousse (a water-in-oil emulsion).

Dr. P. C. Blokker, a research chemist in the Dutch laboratories of Shell Oil Company, concluded after experiments that the visual appearance of oil slicks after a given period of time can help provide reasonable estimates of their thickness. The American Petroleum Institute also made studies on the subject which Alan A. Allen followed up with a quick and reliable system for judging the volume of an oil spill by its apparent color in the Santa Barbara Channel. Oil films less than a millionth of an inch thick are invisible. Those some three one-millionths of an inch thick have a silvery sheen. A narrow range around 1/100,000ths of an inch has the well-known iridescence. At about 1/10,000th of an inch, the oil appears dull but even gentle wave action will break it into streaks or patches. Only if the oil is on the order of one one-thousandth of an inch thick—or more—will it present a uniform blackish appearance. By using this visual method Allen estimates that some 50,000 barrels of oil leaked into the Channel during the first ten days after the blowout.

The infinite variety of oil's possible characteristics helps explain why the British found themselves baffled in dealing with the unprecedented slick from the *Torrey Canyon*. The puzzle was compounded by the addition of vast quantities of chemical "dispersants." The question of how to mount a proper clean-up brigade for spills is still being hotly debated today.

While the British were conducting their frustrating battle to overcome the oil by chemicals and aerial bombing, a quite different approach was being used on the other side of the channel where large amounts of *Torrey Canyon* oil were menacing the shores of Brittany. There the French, typically independent, tried humbler tactics. They used a pumping ship to try to suck the oil directly from the water. This worked where the oil was thick and the water calm. At the water's edge they used pump trucks to suck up more oil. On shore, which presently became covered with chocolate-mousse emulsion, they concentrated on scooping the mess into buckets which were then emp-



Barges fail to keep oil (black streaks) from shrimp and oyster beds near Platform "Charlie" (cover).

tied into pits dug behind the beaches. The gathered oil was then burned. Only to finish the oil removal from the beaches did the French resort to the use of detergent-type chemicals.

The French also tested several other tactics. They spread quantities of straw and sawdust on the sea to absorb oil; straw had much the better success. They sprinkled oil patches on the water with 3,000 tons of blackboard chalk. The purpose was to sink the oil. Apparently it did just that, although nobody could prove in what amounts.

American clean-up tactics have progressed beyond an assortment of European methods. U.S. oil companies have frequently tried different chemicals from among the 400-odd now on the market for combating oil spills. Critics charge that the main value of the chemicals is to "sweep under the rug" the visible mess. Oilmen have hoped that the chemicals would simply facilitate what they trust is oil's natural disappearance at sea.

At San Juan, the bay water was so calm and the oil layer so deep that a small boat pumping up oil and scooping it with a foam-covered rotating drum worked fairly well until it became clogged with debris. Vermiculite, well known to home gardeners, was tried, with some success, as was a material made from broken bits of volcanic glass.

They improvised one weapon after another

When the blowout off California threatened Santa Barbara's beaches, the oil company responsible for the platform assigned one of their most intrepid troubleshooters to try whatever was necessary. It was a hopeless task, but valuable lessons were learned. The oilmen found or improvised one weapon after another. Crop dusting airplanes and a work boat with fire-fighting equipment sprayed chemicals on the oil (without noticeable effect). Floating oil skimmers and tank trucks sucked up oil (feasible during calm weather). Floating booms were constructed of wooden pilings, inflatable plastic, sand-weighted plastic "skirt" sections, steel cables and other materials in various combinations to hold the oil back (some oil went under and over, but the force of the storm-tossed waves broke up the booms anyway).

Gathered and employed were at least 1,000 men, including prisoners from state institutions and hired laborers; 125 pieces of mechanical equipment; 54 boats of all types and hundreds of miscellaneous supplies. Various foams, natural clays and talcs, cement, bentonite, diatomaceous earth and even a refinery item called equilibrium fluid catalytic cracking catalyst were spread by blowers, boats and planes to sink or absorb oil (none was effective). Two "bubble barrier" air-curtain contrivances were tried (they didn't work).

Meanwhile, out at the platform, an equally desperate series of measures were tried to stem the flow. When the well first blew out, with such force that it proved impossible to install shutoff valves, the entire drill stem was dropped down the hole. This stopped the leak from the wellhead, but gas and oil began to boil up through the water nearby, having cracked through the channel floor. So the dropped drill pipe had to be fished out again, and volumes of drilling mud were pumped down the hole. None of these measures completely stopped the oil (some ten barrels a day still seep from the rupture). So huge 100-foot-square undersea tents in the shape of pyramids were installed to collect some of the oil before it reached the surface.

The one weapon which fully proved its worth at Santa Barbara was straw. Mechanically shredded and spread on the water, it absorbed up to 80 percent of its own weight in oil. After it washed ashore, it had to be collected by hand. So available straw supplies throughout the western states were mobilized. Ultimately more than 3,000 tons of straw were used.

Natural seepage: An oil bubble rises from the seabed, 45 feet deep, off Coal Oil Point, Santa Barbara. An estimated 50 barrels a day may leak there but total amount of worldwide seepage is unknown.

The oil spill problem

Obviously, straw is not the surefire answer that will still the alarm over oil pollution. It offered little help when Platform Charlie caught fire early this year a dozen miles out in the Gulf of Mexico. Putting out the fire was difficult enough, but what everyone knew was that once the flames were quenched the oil pollution would start. At stake were rich shrimp grounds and oyster beds nearby. The shellfish could be tainted or killed before any straw campaign could work. As the oil slick built up around Charlie, a string of fixed barges formed an arc in an attempt to keep the oil away from shore. These defenses appeared to be losing when a fortuitous change of weather carried the oil out into the Gulf.

Research is under way to explore better clean-up techniques. The government is supporting some of the studies such as those being made by the FWQA which has been given $3.5 million over the last three years for research on new ways to combat oil pollution. The American Petroleum Institute is conducting a $1.2 million program to develop and evaluate potential ways to pump oil from the sea's surface, to absorb it, to sink it, to disperse it, to congeal it, to contain it in whalelike plastic bags or to "sweep" it with brooms, water jets or "air brooms."

One system called Seadragon employs two boats pulling two huge booms (with hanging skirts) in the shape of a "V" to funnel the oil to a rotating-brush skimmer device; the skimmer is expected to pick up the oil and transfer it to the deck of a trailing work boat, where an oil-water separator will flush water back over the side and pump the oil into a towed rubber storage bag. The developers say months—if not years—lie ahead before they perfect a system that will work in rough waters.

Many of the cleanup strategies—if and when they work—depend on nature and the ocean being able gradually to transform toxic hydrocarbons and foul goo into innocuous substances. Some years ago scientists began wondering where all the spilt oil went and why it had not covered the sea long ago. They developed a theory, now widely accepted, that marine bacteria gradually ate dispersed oil and other forms of petroleum that do not evaporate, converting it into the protein of their own structures. Mathematically, the theory sounds fine. Under controlled conditions the process works so well that some oil companies have been trying to develop it as a potential food source for soaring numbers of starving people. Only recently have doubts been raised that bacteria can perform this duty in marine sediments that lack oxygen. Chemist R. A. Dean of British Petroleum says, "It seems very probable that any oil sunk to the bottom of the sea, where the oxygen content is low, can be expected to remain there more or less indefinitely."

How irreversible is oil pollution damage?

Great uncertainty attends the question of how much irreversible damage oil pollution inflicts on the environment. Many portions of crude oil and most of its refined products are toxic to most living plants and animals and may wipe out a species or sever an essential food chain.

Seabirds that fly and dive for fish, like pelicans, gulls and gannets, are less likely to become covered with oil than those specially adapted birds that feed in rich offshore waters and have thick, waterproof plumage and short limbs adapted for continuous swimming. Once their insulating feathers are even partially soaked with oil they are defenseless against cold water. More thorough oiling makes birds unable to swim or fly, while those still able to try to clean their own feathers by preening inevitably swallow some of the poisonous substance.

After the *Torrey Canyon* spill, some ornithologists guessed that at least 25,000 birds died, many far from land. Bird-lovers tried to save 7,000 oiled birds by cleaning their feathers. Less than one percent survived. Once cleaned, moreover, a bird is still helpless. The cleaning agent removes its natural feather oil, so that if it tries to swim it becomes waterlogged, sinks and drowns. Some birds, notably the loon, cannot walk at all on land, because the legs are placed too far back. One of the worst hazards to many an oily bird that humans try to help is the shock of being handled. Experts sometimes wonder if it would not be kinder just to wring their necks.

Scientists have been studying damage at the site of the main spills, but without an accurate pre-spill census of every species, new counts cannot be conclusive.

Most species of birds involved seem to be repopulating. Certainly some shellfish and finfish have been killed and just as certainly sea mammal colonies near California are *not* wiped out. But whether the fish kill was drastic and whether any seals, sea lions or whales were seriously injured remains unresolved.

Fears for the floating kelp forests in Santa Barbara's waters proved unfounded, for the kelp is protected by a natural coating of mucilage. But on the shore, definite damage was done to eel grass; only time will tell whether it can recover.

Dr. Molly Spooner of the marine biology lab at Plymouth, a member of a sizable scientific team that studied the effects in England, found that limpets not only did not always drop dead at the first contact with oil but ate it, clearing some rocks of tar and leaving tiny toothmarks. But Dr. Spooner also warned, "One must remember that copepods are by no means little automatic filtering machines."

Marine life damaged most by dispersants

One startling conclusion that British oil-slick fighters had never counted on was that chemical dispersants —which themselves possessed a kerosene base and were highly toxic—wreaked far more damage to marine life than the oil itself. Stringent restrictions have now been placed by U.S. officials on the use of anti-oil chemicals though they still appeal to oil companies suddenly confronted with bad public relations and a potentially expensive oil spill.

Another environmental survey team of 40 scientists, also headed by a woman, Dr. Dale Straughan of the University of Southern California, has studied the Santa Barbara scene. Although not yet ready to report on all of her team's findings, she recently said that more than a year's scrutiny had failed to turn up proof of any permanent damage. "Of course," she points out, "permanent effects are harder to find and may take longer to confirm."

At San Juan, also, less biological damage was observed than had been feared when the *Ocean Eagle* first broke apart there.

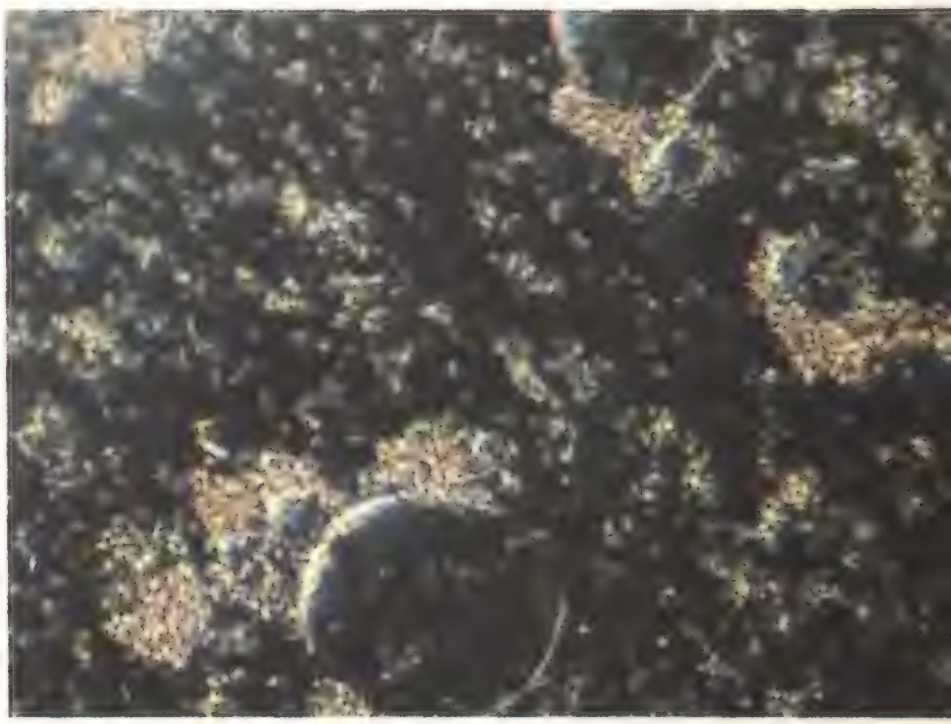
There were tentative suggestions that cancerous growths in underwater animals might be related to oil pollution, and most scientists agree that the tainting of the flesh of commercial fish and shellfish can definitely be tied to oil leaks. But most of these disturbing hints were dismissed as being freak effects of unusual local circumstances. The only reliable overall assessment of oil's environmental hazards was that confusion reigned.

In recent weeks, however, a relatively tiny oil spill in Buzzards Bay on Cape Cod has cast the whole question in a new light. Although the spill happened a year ago and involved only about 4,000 barrels of highly toxic no. 2 fuel oil, less than 1/100th as much oil as the *Torrey Canyon* carried, Dr. Tom Murphy says that "this spill seems likely to have equal or greater impact on our understanding of the nature of the effects of oil pollution. The accumulating body of knowledge is finally beginning to make sense."

What makes the little Buzzards Bay spill a turning point in oil pollution science is that it took place only six miles from the famous Woods Hole Oceanographic Institution, where topflight scientists not only had carefully studied the affected area before the spill but were able to scrutinize the spill's effects when it happened. The qualifications of some of the scientists, including biologist Howard Sanders and chemist Max Blumer, enabled them to combine intensive biological observations both in the field and in the laboratory with modern techniques of chemical analysis.

On the tidal shore areas, where they knew that an average of 200,000 tiny organisms previously lived in every square yard, they now found an average of only two. The massive kill of larger, visible creatures like lobsters, crabs, fish, and worms which washed ashore in smelly windrows after the spill were soon rendered invisible, as the carcasses quickly decomposed and were removed as part of the clean-up operations. New fish, of course, migrated into the area. But after at least nine months the more stationary forms of life, like mussels, failed to repopulate the polluted area; even seemingly unharmed mussels failed to reproduce.

A big surprise was that the oil, including the most



Droplet of crude oil, highly magnified,
is surrounded by lighter bacteria in a Mobile Oil Co.
laboratory experiment. This indicates that oil
might disappear naturally over a long period of time.

poisonous and presumably volatile constituents, permeated the sediments even under 42 feet of water (the deepest part of the bay). Yet it did not stay in place, spreading out to affect more than 5,000 acres, killing bottom life on the entire area.

Studies of affected shellfish taken into the laboratory produced even more disturbing results. Chemical analysis proved that oysters, scallops and clams had incorporated the oil into their tissues largely unchanged in form. Contrary to expectations, oysters transferred to fresh clean water failed completely to rid themselves of any of the oil after six full months. Even when no tainted odor or taste could be detected, the oil remained.

So far nobody has claimed that oil-contaminated shellfish have caused human cancer. But it has long been certain that petroleum contains cancer-producing compounds. Taking into account the findings of other Woods Hole scientists that fish far at sea frequently have little tar balls in their stomachs—and perhaps in their tissues as well—the unchanged incorporation of oil compounds into the tissues of undersea life suggests darkly that the food chain of the ocean could be concentrating potentially toxic or carcinogenic substances in the bodies of organisms that in the end may be eaten by human beings.

What it all means, says Dr. Tom Murphy, is that "we have been so diverted by the visible effects of oil as to ignore its less visible and possibly more damaging effects. Now the time has come to look beyond the visible, not merely with cries of doom, but with competent scientific investigations."

Dr. Blumer agrees. "Certainly the hazards involved are yet to be conclusively determined. My only plea is for information. I do not think we should be deciding on policies in a matter which could prove to be disastrous on the basis of ignorance."

The urgent plea for information applies to all aspects of oil pollution. We should know what really happens to those millions of tons of used crankcase oil, those acres of tar balls, and the bilge from those dirty ballast tanks. If bacteria do indeed destroy great quantities of oil far at sea, maybe they can be husbanded into strains to help keep our shores safer. Surely the technological genius of the world can hasten the invention of better clean-up methods.

Ways are being developed to identify almost every oil spill, either by analyzing its unique composition like a chemical "fingerprint" or by tagging every load shipped with trace elements. The cost of such a system which would pin the blame on hit-and-sail polluters should be far cheaper even to U.S. oil companies than the lawsuits they now contend with, some of which run into the billions. The U.S. government, which takes in a billion dollars in revenue from oil leases, should spend more than 1/100th of that to properly police oil-drilling platforms for such things as storm-choke valves and visiting tankers for such things as leaks and spillovers, if they are to remotely correspond to sound management practices.

Most of all, and most urgently of all, the unknown facts about oil's lasting impact on marine biology deserve far more intensive, far less emotional investigation. We should never forget that our ecological future will always be tied to the sea.

Santa Barbara workers try to scrub a grebe. Right: Beautiful iridescence betrays deadly oil framing a serene view of drilling platforms.

The cow as a factory: It digests by way of its four-chambered stomach of which the *rumen* (forestomach) is unique. Food is swallowed almost whole and bacteria in rumen go to work. Process is continued in *reticulum* (second stomach). The resultant pulp is returned to mouth for mastication. Then it goes to *omasum* (third stomach) and *abomasum* (fourth) where previously proteinless food can be broken down to provide nourishment. Thus even newspapers, a source of carbohydrate, can be transformed by adding vitamins, minerals and urea.

Illustrated by Robert Osborn

By Betty M. Watts

If other mammals, including Man, had cuds to chew...

. . . Like Finland's "Metta," our own placid cows may show us a way to reduce pollution and provide food for millions

We food scientists are confronted now by our sins. Our efforts have enabled millions of people to enjoy gourmet meals, but the waste has been scandalous. As many as half a dozen undernourished Asians or Africans could be fed sumptuously with the cereal and oilseed now being sacrificed to produce a pound of beef or milk protein for a well-fed American.

The earth must support more people from now on. Population trends indicate that by the year 2000 there will be twice as many persons as there are arable acres on our planet. To meet mankind's demands thus far, we have found more arable land and made our farms more productive per acre. Now we have been awakened to the pollution of our soil, water and air by our beefsteak-and-ice cream economy's wastefulness.

Even the sweet fruits of modern technology have become suspect. Who knows what pesticides and inorganic fertilizers may be doing to our foodstuffs? Ralph Nader and others charge that many of these have become dangerously contaminated. A bewildered and nostalgic nation seems to be fumbling for a way back to a simpler, cleaner, more natural way.

But how can we go back? The gates of the Garden of Eden have closed. If there is a way to balance our nutritional needs with our living space, it lies ahead.

The author, a professor emeritus at Florida State University, has been honored for studies of the causes of food deterioration.

Genesis does not tell us whether Eve ate the whole apple or only the choicest part. We have thrown most of the apple away to rot in growing heaps.

Some of the waste matter that is jeopardizing our environment is rich in nitrogenous nutrients. Primitive man's herds ate only the plant food that was abundant around them, but now we have discovered that animal excrements also can be utilized as animal food. We cannot break even in our dealings with energy (as Isaac Asimov explained in the August SMITHSONIAN), but we have often succeeded in making machinery of various kinds more efficient. Even though we cannot feed the food furnace entirely with ashes from it, we no longer have to use the ashes to diminish its efficiency.

A modern saga of the cow encourages me to believe that we are making progress toward a world in which food, waste and chemicals can be brought into a safe, controlled balance. The patient cow is a symbol of both the best and the worst in our present agriculture —and she is moving ahead to new, unfamiliar pastures.

For centuries most men have supposed that domestic cattle had to be fed plant protein. The cow's

"We have thrown most of the apple away to rot"

revolving jaws, however, work over a ferment that is benign rather than destructive. The cow is learning to live with chemicals and to recycle wastes, thanks to 20th-century studies of animal feeding.

The Nobel prize for chemistry in 1945 went to Artturi Ilmari Virtanen of Helsinki, Finland. He will be 76 years old in January 1971, and an extremely abbreviated review of his career fills half a column in the latest edition of *Who's Who in America*. For more than 12 years now Virtanen has been working with cows, usually with only one or two at a time, but with a depth of focus greater than that of most studies of herd-feeding. He has found that cows can grow, produce normal milk and bear healthy calves without any protein in their food.

In lieu of protein, Virtanen has fed urea to his cows. Urea can be made from relatively simple inorganic molecules. It is both a residue from the protein that animals consume, flushed out in urine and droppings, and a common chemical of commerce. Urea is the nitrogen ingredient of many modern fertilizers, and an increasing fraction of the urea manufactured by our chemical industry is now being fed to animals. The 1962 yearbook of the U. S. Department of Agriculture hailed its inclusion in the diet of ruminants, especially cattle and sheep, as an "important advance in animal feeding."

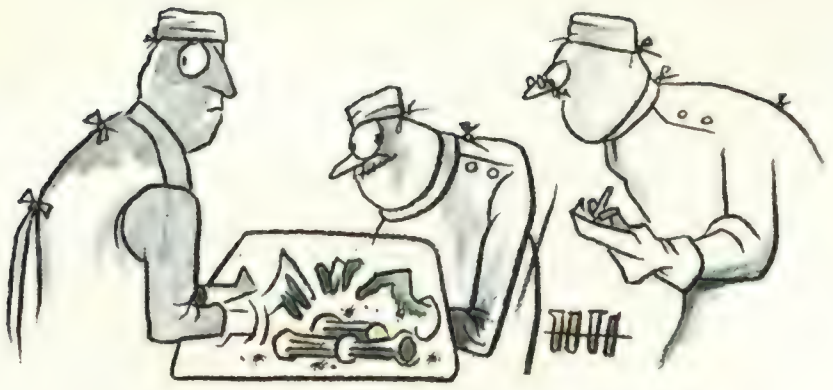
His cows are individuals

Virtanen describes his research in simpler, homelier language than most scientists. He does not speak of experimental animals 1, 2, 3 or A, B and C. His cows are individuals, with real names. Eiru and Aino, he reported in 1966, already had calved three times on protein-free rations. Metta, a comely beast with well-developed mammary glands, has been his star milk producer.

Only a few weeks are required to wean cows completely from standard fodders and adapt them to a urea diet. They can then go on consuming it indefinitely without complaints or complications. Along with the urea, minerals and vitamins, they require a bulk source of carbohydrate—but this does not mean that it has to be provided by starches and sugars acceptable to humans.

The cow can use straw, the pulp from cane or sugar beets, or wood shavings as her source of carbohydrate. Research recently showed that she can even use another kind of waste matter, ground-up newspapers. Nothing in the reported research suggests that the outcome is affected by either the editorial contents or the advertising.

Metta's exploits have been duplicated around the world by sheep and goats as well as by cows, and in



"... Growing bacteria on stalks of cane"

India by buffalo. The U. S. Department of Agriculture has maintained cattle—20 head including bulls and heifers—for more than eight years without feeding them protein. Their diet, including factory-made urea, is under the supervision of Dr. Robert R. Oltjen. Sophisticated American cows, in fact, may soon have a new kind of snack. It is called Starea and was developed at Kansas State University. Starea is a mixture of grain and urea that has been put through the same kind of cooking and extruding apparatus now used to produce odd-shaped dry pet foods and snacks for people.

Unfortunately, only the cud-chewers can turn chemicals and trash into protein internally. Pigs, people and poultry must have protein supplied to them. Yet the bodily processes of Virtanen's Metta are similar to yours and mine. The principal difference is that she has an extra forestomach, a rumen.

It is a large compartment that helps the cow convert coarse, fibrous foodstuffs into meat, milk, wool fiber and energy. The cow's rumen is a veritable powerhouse of synthetic activity. It houses a great variety of bacteria, feeding each other in a happy symbiosis. Some break down the cellulosic trash. Others work over the urea, eventually turning it into protein. The bacteria multiply at astronomical rates. Metta simply accommodates these microscopic protein factories while each one does its thing. Then, as the contents of the rumen pass on to further compartments of the cow's alimentary tract, she digests them.

If people were to dine like Virtanen's cows on cellulose and urea, we would be no better off for its passage through our systems. We have no internal processing plant to serve us the way the rumen does the cow. But there is nothing to stop us from setting up an ersatz rumen on any laboratory tabletop. Little more is needed than a flask containing a solution of salts held under as warm and airless an atmosphere as prevails in Metta's forestomach. The solution in the laboratory flask could be inoculated with a thimbleful of rumen filched from a cow. Then when an assortment of carbohydrates and waste products, which might be the equivalent of urea, was added our imitation of a rumen would begin to function like one produced by nature.

Theoretically, we should be able to beat Metta at her own game by isolating the most efficient organisms and arranging conditions to their liking. A large-scale hothouse for bacterial protein production, patterned after Metta's rumen, is not a dream.

Regeneration of food from wastes may be necessary on long journeys into space. The National Aeronautics and Space Administration and the University of South Florida have co-sponsored two conferences on nutrition in space and related waste problems. An investigator reported at the most recent one that it may be feasible within the next decade to use some of the waste matter to supplement the supply of food in a spacecraft.

Along with a great many quite different activities, a NASA research and testing complex now houses a small pilot plant at its Mississippi Test Facility for growing bacteria on stalks of cane from which sugar has been extracted. This facility is on the Pearl River boundary between Mississippi and Louisiana, where stalks are now an unused by-product of sugar refining. Louisiana State University engineers, with a grant from the Bureau of Solid Waste Management, and in a sometimes uneasy alliance with bacteriologists and nutritionists, have been trying there to find a new use for this waste matter.

They have been growing pure cultures of *Cellulomonas* bacterium, one of the many types that lurk in the fields of rotting sugarcane, on chopped up, treated cane stalks. Then they have been harvesting the microscopic cells, drying them and producing a coarse powder to feed to laboratory rats. Compared

"It insists on having ammonium salt"

to Metta's calm efficiency, their efforts still seem somewhat amateurish. The *Cellulomonas* bacterium has been found to be reasonably efficient in chewing up the cane, but fussy about its source of nitrogen for building protein. It insists on having ammonium salt rather than urea.

The microbial protein, moreover, is packaged in tough little cell walls that are impervious to the digestive juices of rats. Every step of the process seems to have brought new problems to light. Bewildered engineers have sometimes told the nutrition specialists: "Your rats could not have lost weight on that last batch!" The Pearl River plant cannot yet even pretend to rival the ruminants in the surrounding countryside. Its assorted scientists are groping with discouraging realities because they are sustained by a vision of future supplies of nourishing food, produced from waste by microscopic organisms under man's control.

"Nature her custom holds," said Hamlet. "Let shame say what it will." While we struggle to duplicate or improve on the cow's rumen, nature pushes on. Nitrogen spills out of every man, beast and bird. The disposal of sewage and dung has become one of the major challenges to the engineers striving to save our environment. Scientists, meanwhile, have begun to seek ways to make use of animal wastes. Proponents of "organic feeds" should be pleased.

Under the wary eye of the Food and Drug Administration, Dr. Joseph Fontenot and his associates at Virginia Polytechnic Institute are assessing chicken litter as a feed for ruminants. Young birds are raised on carpets of materials such as wood shavings. By the time the chicks are ready for market, the shag rugs are thoroughly impregnated with droppings. In this country some 50 million tons of such litter must now be disposed of annually.

It is rich in protein and nonprotein nitrogen. So Dr. Fontenot has laid aside aesthetic considerations, sterilized such litter to ensure the demise of pathogenic organisms, and tried feeding it to cattle and sheep. It can be substituted, he has found, for about half of their total ration. Animals put on this new diet have produced normal-tasting meat so far.

At Auburn University in Alabama, Dr. W. B. Anthony has fattened steers on the abundant animal excrement commonly used to fertilize soil. When it is accompanied by enough regular feed, he has discovered, as much beef can be produced as with conventional fattening rations. The system is not self-supporting because the animals balk at more than half, leaving Dr. Anthony with the other half to dispose of in some other way. He is pushing ahead, therefore, with plans to upgrade manure by a fermentation process. The fermented product may have better nutritional qualities and steers will possibly find it more acceptable.

"Your rats could not have lost weight"

Wary FDA assesses droppings for feed

There are no records of attempts to feed human wastes to ruminants. Microorganisms, however, have long been helping us dispose of such wastes. Domestic sewage can serve as a diet for algae after being worked over by appropriate bacteria to break down some of the organic material present.

To reduce the pollution of San Francisco bay, Dr. William Oswald and his associates in the Department of Sanitary Engineering and Public Health at the University of California have laid out a series of shallow ponds on flatlands adjacent to the bay for the culture of microscopic green algae. The engineers attending those ponds report that, in addition to purifying the water, algae can produce a ton of protein on less than a tenth of the land and one-fifth of the water required to grow soybeans, our major protein crop.

To a casual viewer at present, this serious attempt to solve a serious problem may seem childish play. When a scoopful of concentrated algae is taken out of a centrifuge, it is so deeply pigmented that it is almost black. This sludge is put into a dryer or spread out on a plastic sheet to dry in sunlight.

When offered a handful of the dried flakes, a horse rolls it around his mouth gingerly and draws his lips back in evident distaste. But goats, we are told, have eaten it. When it is pelleted with barley or other grains so that the dark flakes cannot be nudged aside, other animals will eat it, too.

All of the organized efforts that I have mentioned to meet current problems are still experimental. Some of them may be taking us a few steps closer to what the aerospace food technologies call "a closed life-support system." There is no broad, open road to a clean and shining future.

Even Finland's chemical-eating Metta and her American cousins may present us with problems that have not yet attracted city folks' attention. Dairy cattle on normal diets chew their cud from seven to ten hours a day and have to belch. Fermentation in the rumen produces large volumes of carbon dioxide and methane and lesser quantities of other gases that must be expelled.

To combat pollution of the environment without causing a shortage of food we must find chemicals that will serve their purpose without accumulations that spoil our land, water and air.

The gradual blurring of the sharp line that we draw between "useful" matter for consumption and "waste" for dumping may be a fortunate trend. That distinction has been costly to our planet and may eventually have to be filed and forgotten. In one way or another, the descendants of Adam and Eve may be forced to stop trashing their environment. One way just may be to accept the whole apple of knowledge.

"But goats, we are told, have eaten it"

Metta, the queen of them all

A sad monument to air pollution

"Cleopatra's Needle" may have survived three millennia in the Nile Delta, but 90 years in New York have done it in

Standing on a knoll in New York's Central Park is a tall granite obelisk, two of its sides covered with hieroglyphics and the other two blurred by erosion.

A timeworn object, you would say. But time had little to do with it. The obelisk and its twin, now in London, were erected in Heliopolis, Egypt, about 1500 B.C. and moved to Alexandria in 14 B.C., where they eventually acquired the name of "Cleopatra's Needles" (erroneously—she had nothing to do with them). There they stayed until the early 1880s, when the Khedive of Egypt sent one to London and one to New York, both in mint condition, as goodwill offerings.

New York's rains and frosts are hard on objects preserved by the aridity of the desert. But if that were all, the wear and tear on Cleopatra's Needle would be uniform. Instead, its south and west sides are worn away. These are the directions of prevailing winds in New York, and the inescapable conclusion—supported by experts—is that wind-driven chemicals have eaten away the surface.

"Ninety years in New York," says a park official, "have done more damage than 3,500 years in Egypt." The Needle is an unwitting monument to pollution.

These photographs show the effects of pollution on "Cleopatra's Needle": the undamaged east face, the obliterated west face (center), and the contrast between north and west faces (far right).

Ventures In Design

NUMBER 7 IN A SERIES BY ALUMINUM COMPANY OF AMERICA

A Still Water Aerator
By Craig Vetter

The seventh recipient of a commission in Alcoa's "Ventures In Design" program, Craig Vetter, is seriously concerned about pollution. A student of ecology, he feels that a designer's most important job is to "plan our increasing industrialization so that it does not further disturb the balance of nature." His aerator is designed as a temporary method of preventing the destruction of slow-moving streams and ponds until we can control the man-made pollutants that are choking them.

The design.

Effluents with nutritive value are accelerating the death of streams and ponds by eutrophication. (When the amount of mineral and organic nutrients increases, it force-feeds and causes rapid multiplication of aquatic life, especially algae. This, in turn, reduces the level of dissolved oxygen and produces an environment that favors plant over animal life.)

Vetter's device replenishes the oxygen supply so that it can adequately support animal life needed to keep the body of water fresh. It works on the principle of Boyle's law of expanding gases, providing air at night when algae consume oxygen and when the dissolved oxygen level is lowest.

The black, finned cylinder at the top contains a small amount of a liquid fluorocarbon with a high coefficient of expansion. Below it, a parabolic reflector directs sun rays at the black cylinder (which acts as a heat sink). During daylight hours, the gas expands and pushes down its piston and a slave piston in the larger cylinder below the reflector. This cylinder collects air through a one-way valve. When the gas contracts and the pistons return to their original positions, the air is expelled into the water at night through another valve. The air is released at a slow, predetermined rate through a long tube made of permeable membrane.

The designer envisions the use of his aerator by governmental bodies and volunteer groups, especially in the flat Midwestern areas where streams move slowly.

Aluminum, the designer's metal.

The finned heat sink on Vetter's device is a black, anodized aluminum extrusion. The lower cylinder and both pistons are drawn shells of the same metal. And the reflector is spun and polished aluminum. The designer chose aluminum primarily because of its excellent heat transfer properties. Other contributions aluminum made to the design were light weight and high corrosion resistance. We applaud his choice, and hasten to mention that no other material can be formed and finished by so many methods.

Selection.

A panel of distinguished design educators assisted us in choosing the recipient of this seventh commission in Alcoa's "Ventures In Design" program. They were: Arthur J. Pulos of Syracuse University, Joseph M. Parriott of Pratt Institute, James M. Alexander of the University of Cincinnati and Edward Zagorski of the University of Illinois. The program was conceived as a way to recognize the work of young professional designers of ability and promise. Designers selected get a cash award, materials and technical assistance from the Alcoa design division.

The designer.

A 1965 graduate of the University of Illinois at Champaign-Urbana, Craig Vetter won an Industrial Design Society of America award as an undergraduate. On the staff of the University after graduation, he designed a simplified balance and a microscope for lab use. In 1967 he set up a design firm to develop new products. One offshoot is Vetter Fairings Co., which manufactures and sells motorcycle fairings (attachments that cut wind resistance on long trips). And he recently designed an American-oriented, 750 cc motorcycle for a leading British maker.

Alcoa is the designer's ally.

We maintain our own design division to communicate with both consultant and corporate design personnel about Alcoa® aluminum alloys, fabricating techniques and finishes. And we have sponsored both professional and student design awards for many years. Consultation with our design division is just one of the services available to you from Alcoa. For more information, call your nearest Alcoa sales office listed in the telephone directory, or write Robert P. Eganhouse, Manager of Design, Aluminum Company of America, 1058-L Alcoa Building, Pittsburgh, Pa. 15219.

Change for the better with Alcoa Aluminum

ALCOA

Anthony Caro: *The Window* (1966-67), painted steel, 62⅝″ x 126⅜″ x 153½″. Caro is the acknowledged leader of the younger British sculptors, and this is typical of his work—big, cool, clean and dramatic.

Kasmin Limited, London

By Norbert Lynton

British art today– not quietly dead but 'quietly active'

This month the National Gallery will provide examples with a major survey of the British art of the sixties

Britain, readers may recall, is a small island to the west of the continent of Europe, at its closest point only 21 miles away. Those few miles of water symbolize, as well as condition, its cultural situation. There lies the island, nominally within Europe yet not of it, close to France yet utterly separate, as the French and the British well know; also markedly farther north and for much of its length more accessible to and from the Netherlands.

Add contemporary methods of world communication as geographical facts of another sort, and the picture changes. The island off the west coast of Europe is now not much farther off the east coast of the United States. The English-Speaking Union was created 50 years ago to encourage interchange between these two then-distant countries on a serious cultural level. Today this interchange is unavoidable, but it takes place on many levels—from Rolling Stones to the Union's anniversary exhibition of recent British art at the National Gallery in Washington this month.

The difficulty lies in judging its proportions. In my teens I slept some nights in a Venetian youth hostel, lying under the two magic signs on its otherwise bare walls: a crucifix and the Coca-Cola disc, side by side. I recognized then that the American way of life had become an export line, where once it had been a synthesizing of imports. The imports that affect it

Norbert Lynton, formerly art critic for The Guardian, *is now director of exhibitions for the Arts Council of Great Britain.*

today rarely originate in Europe. On the other hand, we in Britain do adopt a lot that is yours; even our non-American importations often reach us after packaging, processing and promotion in the States. Yet we don't think of ourselves as an appendage of America, culturally or otherwise. The fact is that the wave of American influence that has marked the last 20 years has coincided with a cultural renaissance in Britain. It was built up on the pioneering and pamphleteering of France and other European culture makers before 1939, on an acceptance of European modernism as neither good nor bad, neither to be welcomed nor to be rejected, but as basic data.

To my parents, arriving from Germany in 1938, Britain was *das Land ohne Musik*. The phrase fixed itself in my mind as a slogan long before I found out it was the title of a once fashionable book. Britain had not contributed anything to architecture since the lucky chance of the Crystal Palace, nor to art since the Englishness of English art had been settled by Constable. No use insisting on Britain's wide influence on art and design through pre-Raphaelitism and the Morris generation because that resulted in Art Nouveau, then thought best forgotten. Theater, opera, ballet, film? Second-rate, not to say awful. Even the kind of study that gives voice to cultural events was disregarded: before 1939 only one British university had begun to recognize art history as a fit subject. Only literature and literary criticism appeared to have any life in them.

Today Britain, to phrase it modestly, is recognized as a worthy contributor on all these fronts, as producer and consumer. Traditional attitudes still hamper us—especially the one that, without quite condemning it, prefers to see culture as something that happens in private between consenting adults. The result is that public patronage is small while private patronage is less, lacking the tax incentives that might spur it. The art-dealing boom has benefited few living artists. What we do, we do on a shoestring, and this applies particularly to national self-promotion. We have the British Council whose function it is to spread the English language and British civilization, and ably it does so. But it is characteristic of our ways that this activity has had to be aimed at countries where our influence was thought to make a useful impact politically, the Near and Far East, eastern Europe and such. The exhibition of recent British art opening this month at the National Gallery in Washington (some examples of which appear on these pages) marks the first occasion that the British Council has been permitted to direct its efforts at North America.

Culturally the war confined us, turned us in on ourselves. In many respects it was liberating, but in art Britain marked time, even regressed. Just as the 1914 war had ended what might have been a valid wave of modernism in British art, so the 1939 war demolished most of what had been achieved in the way of abstraction and surrealism in the immediately preceding years. British artists were driven back onto the traditional British resources: the feeling for atmosphere, for landscape of an intimate sort, for Gothick sentimen-

Courtesy of the artist

Victor Pasmore: *A Harmony of Opposing Forces* (1962-63), painted relief on wood, 60″ x 60″. "Pasmore was evidently jettisoning his skills and poetry for a game that to many seemed both foreign and barbaric."

David Hockney: *Henry Geldzahler and Christopher Scott* (1969), acrylic on canvas, 7′ x 10′. A leading British Pop artist focuses on the Metropolitan's curator of modern art and his magnificent 1930s sofa.

The Waddington Galleries, London

Harry N. Abrams Family Collection, New York

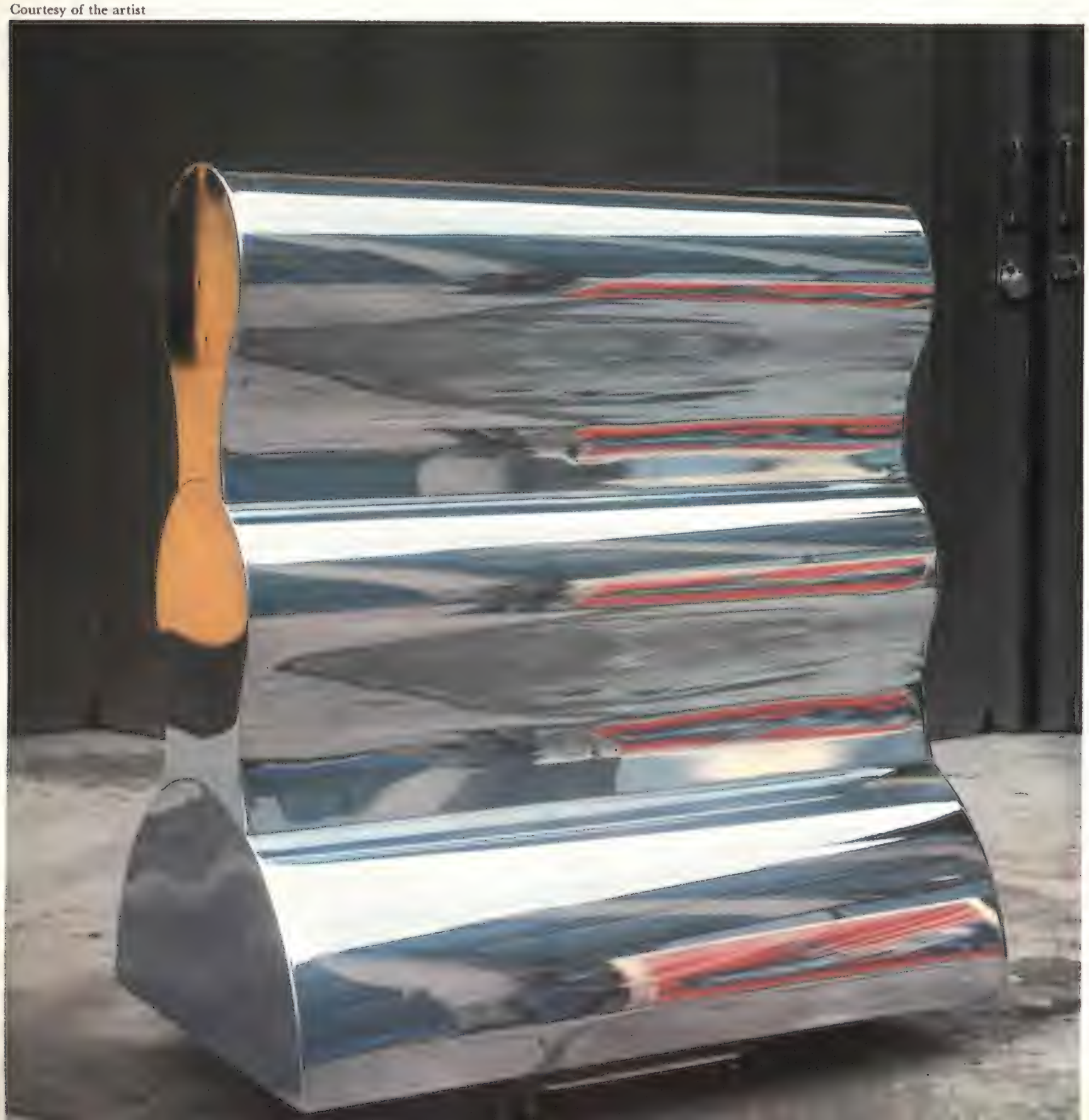
John Hoyland: *9.8.69* (1969), acrylic on canvas, 78″ x 144″. Hoyland was one of the artists involved in the "Situation" exhibition in the early sixties, most of whom have played important roles as teachers.

tality and its alternative, Augustan understatement.

In 1951 Penguin Books published Herbert Read's survey of the British art scene, as progressive a selection as anyone could have made at the time. Read's 70 illustrations are firmly dominated by portraits, landscapes and still lifes, even though pride of place is given, by way of the color frontispiece, to a characteristic Ben Nicholson: hints of landscape and still life within an abstract construction of lines and planes.

Abstract art was still a very controversial matter—surprisingly so considering the quantity and the quality of the abstract work produced here in the '30s. Victor Pasmore's move in 1948 from figure and landscape painting to making pictures, and then reliefs, of abstract forms disposed in rhythmical relationships,

Courtesy of the artist



caused something akin to a public outcry. An outstandingly gifted seminaturalistic painter, Pasmore was evidently jettisoning all his skills and poetry for a game that to many seemed both foreign and barbaric.

Yet by 1950 there was a considerable school of abstract art in Britain. Its leaders were Nicholson, Henry Moore and Pasmore—the first two more established in fame, the last of especial importance through his compelling activity as teacher. By the mid-'50s abstract art was fashionable among those who interested themselves in contemporary art. Signs of international recognition helped (although they got precious little notice in the press). The big sculpture prize at the Venice Biennale went to Moore in 1948 and to Lynn Chadwick in 1956; Nicholson won top prizes in the Carnegie International in 1952, at Venice in 1954, the Guggenheim International in 1956, the São Paulo Bienal in 1957. Even in Britain a suspicion began to grow that our art could hold its own abroad. This gradually weakened the ancient conviction that, outside literature and gardening, creative activity in Britain would always be provincial and unprofessional.

At this point came the American impact. A few British artists already knew something of what was going on in New York. But for most of us it happened through two exhibitions sent abroad by the Museum of Modern Art: a mixed exhibition of contemporary American art in 1956, including a couple of Pollocks, de Koonings, and so on, and an exhibition of 17 abstract expressionist painters in 1959, both shown at the Tate Gallery.

British art critics, almost without exception, reacted badly. This should be contrasted with the warm reaction on the part of British artists—as, for instance, in the enthusiastic review the painter Patrick Heron gave the 1956 exhibition in the New York magazine *Arts*, which, it has been said, helped to establish the Pollock generation in the eyes of the American public as well. By 1959 many British artists, not only the youngest, shared Heron's enthusiasm. Some of course became paint-slingers overnight, but usually the reaction was more constructive. Painters and their public were now forced to consider elements that had not recently been important in British painting, size and scale, the possibility of structure within spontaneous action, the question of image and environmental presence.

There was another impact about the same time, surreptitious and working through painters' talk rather than public events. That of Matisse. His work was not unknown before, of course, but it was given renewed actuality by the fact of his death in 1954, by the brilliantly avant-garde nature of the work he did during the months before his death, and by the retrospective exhibitions in Paris in 1955 and 1956.

The general result was a quickening of the British artistic pulse. With it went a sharp impatience with what was left of wartime romanticism and with genteel dilettantism. The new American paintings that we saw in those exhibitions (and there were also large one-man shows of Pollock, Tobey, Rothko and others) radiated a catching assertiveness in place of the tentativeness and delicacy that had seemed to be the core of the prevailing fashion in art.

For a new generation, American heroes

The generation (using the term loosely) of Pasmore, Heron, William Scott and Terry Frost felt confirmed in aspects of what they had been doing before. They had already rejected prewar illusionism and now their work tended to become larger and bolder, and more reliant on color. But a younger generation was emerging that had less to turn away from and could move directly into positions akin to those of their chosen American heroes. In reaction, perhaps, to the painterly abstractions of Heron, Scott and Frost, most of them attached themselves to the harder and more geometrical side of abstract expressionism, the side of Barnett Newman, Ad Reinhardt and Ellsworth Kelly.

There were two important exhibitions in 1960 and 1961 under the catchword "Situation," arranged by Lawrence Alloway. The only truly common factor in the work shown was size. Otherwise the exhibits varied in style and medium, although both shows were dominated by the sort of formal abstraction that people call hard-edge, and both looked strong, tough, and a little solemn. No one was left in any doubt that the British art scene had changed with this new arrival.

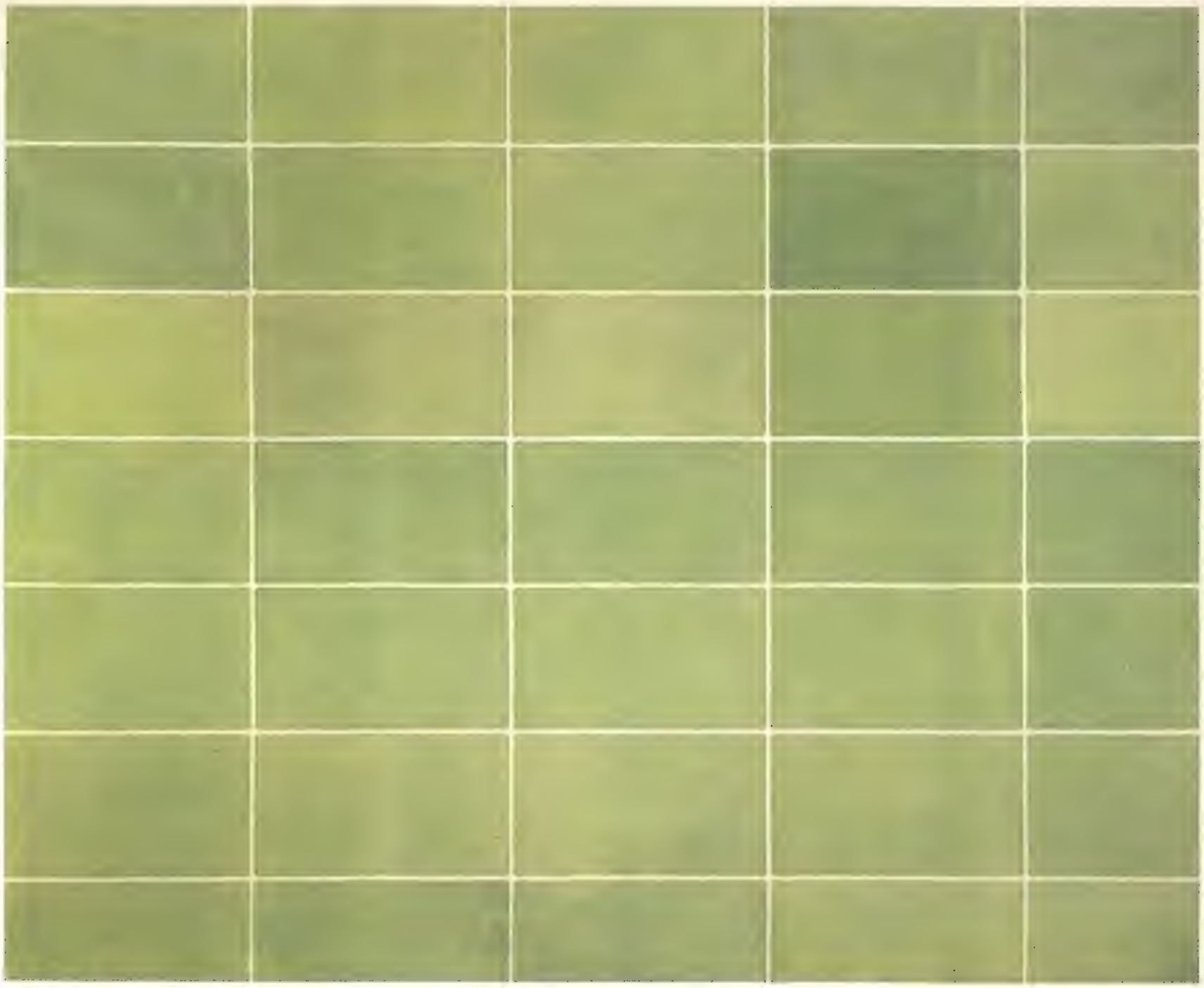
Almost all the artists involved have continued to play leading roles, and some of them are represented in the Washington exhibition: Robyn Denny, Richard Smith, Bernard Cohen, John Hoyland. Although they had only recently been students themselves, these painters took on part-time teaching jobs and greatly contributed to what amounted to a boom in British art schools. The introduction there of a much more liberal system—astonishingly so, considering that all these schools are run on public money—coincided with tougher courses with more intellectual content and an almost lavish provision of equipment and facilities. Through the artists' involvement in the schools, "Situation" attitudes found the most effective amplification.

This is particularly significant in the case of An-

Eduardo Paolozzi: *Etsso* (1967), chromium plated steel, 55″ x 48″ x 31″. The sleek, shining skin of this sculpture will seem something of a departure to Americans familiar with Paolozzi's rugged bronzes.

The Tate Gallery, London

Alan Davie: *Entrance for a Red Temple No. 1* (1960), oil on canvas, 84″ x 68″. Among British painters, Davie was one of the first to recognize the American explosion of the early 1950s for what it was.



Rowan Gallery, London

Mark Lancaster: *Zapruder* (1967), Liquitex on canvas, 68″ x 84″. Lancaster, with his subtly varied rectangles, is one of the "substantial" artists to have come forward since the advent of Pop art.

thony Caro, the one sculptor in the 1961 "Situation." Caro's new work was abstract, large, rough and dramatic, a welding and bolting together of sheets and sections of scrap steel, painted all over in one color and shown on the floor. I remember well how his piece looked in the 1961 show, how it went with the general tenor of the exhibition but also challenged the paintings' existence in a separate sort of space. There had of course been constructed steel sculpture in Britain before 1961, though the scene was dominated by semi-figurative surrealism. Caro's work was a different kind of object, neither formal nor informal, and almost embarrassingly intrusive into man's territory, although also self-contained. Caro rapidly won leadership of younger British sculptors, again through teaching as much as through example. Not that he set out to create Caro disciples, though imitators did inevitably arise. He and his work acted as a challenge to sculptural habits of thought and action. Some young sculptors responded brilliantly to this challenge and went on to do work that bears little relationship to Caro's, notably Phillip King and William Tucker, both, like Caro, represented in the Washington exhibition.

All this augured well for British art in the '60s. Yet while the interested public was still coming to terms with it, a new movement erupted, apparently to counter everything that had just been established. In 1961 and 1962 the Young Contemporaries exhibitions (annual shows of student work organized by the students themselves) gave prominence to the phenomenon we now know as Pop. Figurative, even narrative, sometimes sexy and often amusing, it was an immediate hit. The news media were grateful for a form of art they could exploit (the "Situation" thing was too bare and stern for that). The public was glad of an art that could be linked to both Hogarth and *Alice in Wonder-*

land. Few were aware that enthusiastic and sometimes pedantic exploration of the world of urban culture and commercial artifice had been going on in London for at least 10 years before that.

The antagonism and defensive attitudes that Pop produced in key places in the American art world were not noticeable in Britain. We welcomed Pop because it found a place for sorts of inventiveness and intelligence not employed in other art forms, and because it got rid of the old modernist conviction that literature and art must be enemies. We welcomed it also because it brought out the unmistakable talents of such men as David Hockney, Peter Blake and Allen Jones. It made us realize that there are many mansions in the house of art.

There has been no comparable new arrival since. Very substantial individuals have come forward, such as Patrick Caulfield, Mark Lancaster and John Walker. Op art had a short run as a movement though individual artists who contributed to it have gone on to work in diverging ways. Bridget Riley should be represented in the Washington exhibition but cannot be. Her work is relatively well known in the United States, however, through one-man shows and through her prominence in the Museum of Modern Art's "Responsive Eye" show in 1965. The habit-breaking impact of Caro plus the development of a new range of media and techniques (notably the use of reinforced resin) have produced a wealth of good sculptures and a significant change in the ratio of sculptors to painters.

But no major new movement or event. I think that one reason is that many of the leading artists I have been referring to are still very young. This has several consequences. The presence of these men in the art schools is still dominant and they are not easily sidestepped by their students. They consume more or less all the promotional energies that the commercial galleries and national organizations have to offer. London may be the international center for art dealing, but contemporary British art does not have much of a share in that, especially in a time of credit squeezes and stock market recession. The commercial channels are fully in use and their controllers see little reason to try new lines when the successful ones they have already give them enough to do.

Present essays in "impossible" or "conceptual" art, or whatever one is going to end up calling it, are one sort of reaction. In spite of their weaknesses and pretensions, they do manage to cast a discomfiting light on the stars of the commercial system, and they do almost manage to open up new channels of promotion separate from the commercial system's (although it is

remarkable what that system, and the clients that make it possible, will swallow). Another reaction is not to react, but to recognize that the areas opened up in the early '60s are vast and not to be abandoned without loss.

The Washington exhibition can only be an introduction to all this. It represents a personal selection for an impersonal purpose. Thus it cannot give the feel of the British art scene. For instance, we in Britain rightly or wrongly tend to take the Moores, Nicholsons, Pasmores, Bacons and so on for granted, and look to the younger people for the contemporary life of art. We have begun to take your big shots for granted, too—not so much a reaction against American art promotion in Britain as a measure of its success. It has been a while since anything you sent us has stirred us the way Pollock and Rothko did, that day a century or so ago. Come to think of it, nothing from anywhere has really stirred us up recently. A lot of effort is going into creating space and opportunities for artists and into making the world more aware of what is being done. Apart from that, the British art scene seems relatively quiet just now—quietly active, not quietly dead. I suspect the same is true of the American. I am certain it's a matter of *reculer pour mieux sauter*. That is the way art moves.

John Walker: *Big Green* (1969), an acrylic on canvas, 105″ x 264″. Big indeed—the immense scale of this painting is indicated by the size of the railroad cars against which it was photographed.

Nigel Greenwood Inc., London

By Stephen F. Wilder

Colleges tackle air pollution by 'racing' clean air cars

Whining and hissing, 43 ingenious autos, engineered by students, give a glimpse of driving without foul exhaust emissions

If you've been wondering if those kids at college *ever* do *anything* constructive, let me tell you about the Clean Air Car Race. It had its small beginnings three years ago when Wally Rippel, who had built his Volkswagen bus into an electric car at Caltech, was about to move East for graduate studies at Cornell. Since he had to get the car East, too, he and his faculty advisor, Dr. Jerome Shapiro, decided to challenge the students at M.I.T. to a transcontinental race for electric cars. Students of Dr. Richard D. Thornton accepted the challenge and the two-car, two-way race, after much dickering over rules (How much should cars be penalized for towing? Is battery charging time equivalent to driving time?) actually took place in 1968: the "Great Electric Car Race."

M.I.T.'s electric Corvair got to Pasadena 37 hours before Caltech's VW reached Cambridge, but its crew, resorting too often to towing, lost on adjusted time.

Late in 1969, survivors of both crews decided that it was time for "Son of the Great Electric Car Race." Bill Carson and Dave Saar at M.I.T. wanted a race for any kind of car that could meet the 1975 federal standards for exhaust emissions. Rippel wanted one for pure electrics. The two events soon became one.

The major element in scoring was to be exhaust emissions. These had to be measured four times: once beforehand to qualify the entry, one time each in a slightly simplified fashion at both Cambridge and Pasadena to establish a deterioration factor for the 3,600-mile jaunt (some experimental devices have the lifetime of a mayfly), plus a very complete analysis in Detroit, home of both the auto industry and most of the nation's emission-measuring equipment.

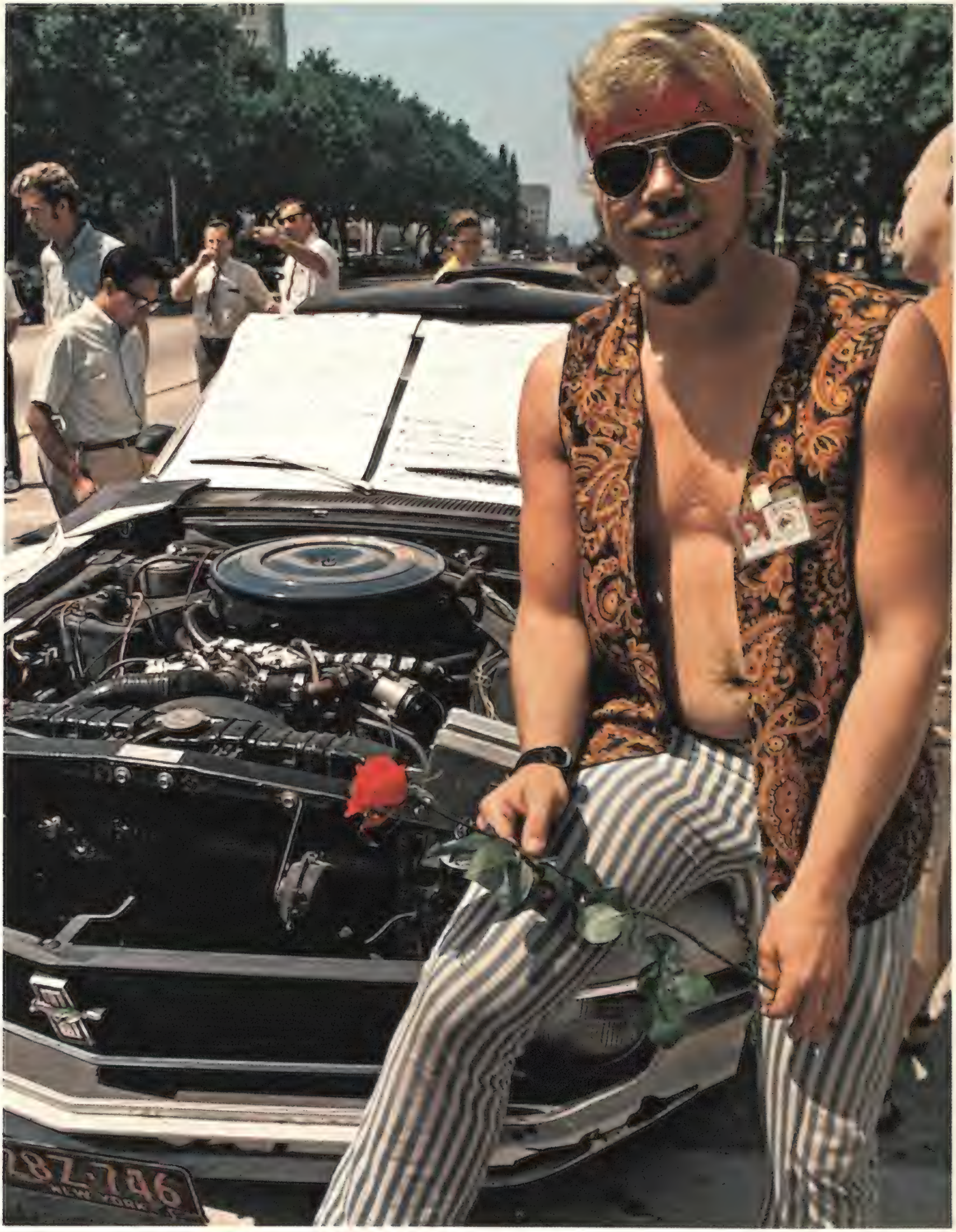
Suitability for normal use by consumers also was made to count. Performance (acceleration, noise level, braking and maneuverability) and economy were separately scored and totaled. This score—which was fairly easy to earn—was multiplied by the hard-won score for emissions. This meant that cleanliness was the aspect that counted. A student committee appointed a panel of five experienced in air-pollution control to select the overall winner subjectively.

The rules placed no limits on commercial assistance or participation except that the driving and all on-the-road repairs had to be performed by the nominated team of two to four students currently in good standing at a recognized college or high school.

Electric utilities hooked up a chain of 69 specially built battery charging stations all across the continent just for the electric cars (whose fuel economy was judged arbitrarily on the kilowatt-hours required at these stops). These were generally located at interchanges, sometimes in a motel parking lot or at a filling station (Fill'er up with electrons!). Recharging took 45 minutes or so, and stations were placed every 40 to 70 miles. Obviously the pure electric is not the answer for long-distance travel unless you like to write lots of postcards.

But long-distance events are a good way for generating publicity, for each evening you are in a different part of the country. On the other hand, this was not merely a publicity stunt, but a Happening, each person being involved in his own way. The committeemen

A free-lance automotive writer, Stephen F. Wilder, formerly manufactured Omega sports cars. He trailed this odd experiment through halts and starts.



Walter V. Thompson, captain of a Worcester Polytechnic Institute team, displays its "Dark Horse," a Mustang with a converter to reduce pollutants.

were organizing and reorganizing—there were bitch sessions almost every evening—and old rules were amended and new ones promulgated. Entrants with more technically ambitious cars were repairing or modifying them at what seemed every opportunity.

Some colleges saw in the race a chance to discreetly toot their own horns. Worcester Polytechnic Institute scored a coup by entering five different cars, two of which wound up class winners. The response of other school administrations ranged right down to refusal to grant money for travel expenses. After all, who could predict what the race would be, or what the students would get out of it? (One student observer wanted only to get to Disneyland.)

General Motors gave 20 Chevelles (plus $2,000 each) and many a lesser firm contributed to one team or another, sometimes a whole car, sometimes bits and pieces or even advice. Mike Bennett's turbine-powered pick-up truck at M.I.T. was rumored to have received $11,000 worth of Dr. Charles Stark Draper's time and interest. The University of Michigan team doubled up with joy and doubled its efforts when their attempt to promote a fuel injection kit from Ann Arbor's VW dealer (they wanted to use it for water injection on a Chevelle) won them both the desired parts and a complete VW to run as a second entry.

Perhaps because Avis was cosponsoring Boston University's electric car, Hertz offered a Mustang to Worcester Polytechnic Institute. This exploitation was limited to the Hertz key fob. Perhaps management felt that when you are number one, there is only one place to finish. Until you know you are in the lead, don't write that press release!

The Ethyl Corporation, whose management, along with du Pont's, is understandably concerned about being pushed out of the lead business. Both firms are working vigorously to meet the stiff 1975 and stiffer 1980 standards with techniques permitting continued use of lead as an octane-raising additive. An entirely different approach is called for, featuring a novel carburetor, lean mixtures and thermal reactors, plus aerodynamic tricks in the muffler to shake out the lead and carbon particles.

Ethyl sponsored the Louisiana State University entry, taking the students through a cram course in Detroit so they understood the theory and practice of

S.M.U.'s 1970 Mustang is given final pre-start emission test. Ducts lead to test chamber. Car exhausts were checked at different speeds.

Car trunk holds liquid gas tank. Liquid propane gas proved to be the most widely used propellant, driving 13 entries. Six cars used liquid natural gas.

Ethyl's somewhat complex but not too expensive—$120 per car—system, and providing mechanics and an engineer to assist them in installation on a Pontiac Le Mans. Somewhere along the way to California, the L.S.U.-Ethyl car came a cropper, as it did well on carbon monoxide and particulates, but very poorly on unburned hydrocarbons and oxides of nitrogen, the key elements of Los Angeles-style smog.

One should be careful not to damn a system because its representative fared badly in this race. Countless exigencies hurt many of the entries, and poor planning or awkward execution or simply getting lost in Texas (University of South Florida's El Camino overshot Amarillo by 35 miles) are hardly technical defects. But it is fair to conclude that the exhaust emissions of gaseous-fueled cars (propane, butane and natural gas) can be more easily controlled than cars burning even unleaded gasoline; that turbines, steam cars and electric hybrids need much more development; and that pure electrics should stay close to cities.

The winning Cornell electric, a converted Hornet that had been bought by Arthur Godfrey, was one of only two to go the distance to Pasadena, and both arrived two days behind the fuel-burners. No steam car made more than four miles under its own power.

The variety of cars entered spanned the entire automotive spectrum. There were pearlescent and candy-apple multi-hued custom paint schemes, and there were bent metal uglies with body by can opener. There were sports cars and coupes and sedans and pickup trucks and panel deliveries. There were cars with readily available bolt-on bottle gas conversions with no emission control equipment, and there was Wayne State University's beautifully turned out, carefully documented and much, much modified Ford Capri.

The Wayne teams key members, full-time carburetor experts at Ford (and night students at Wayne), flunked the critical emissions test in Detroit when they forgot to push in the manual choke knob after making the requisite cold start. Upon request, an unofficial rerun was performed during which they matched the 1980 standards. It was unofficial for points, but the five judges soon heard of it. This, together with the car's excellent performance and immaculate turnout, won their enthusiasm and so Wayne State's team won the grand prize.

But even this performance and that of four cars running on propane, one on alcohol and one on natural gas which tested out consistently with exhaust emissions below the prescribed 1975 levels, must be taken with a grain of salt. For the government-specified test procedure is itself changing drastically.

So what did the race prove? That the clean air millenium is not here, but that there are students who find the future a challenge—even fun. To the educational community, the path is open to a new genre of intercollegiate competition that eschews athletics and involves politics without noisome rhetoric. To the U.S. Senate the race was a decided influence when it voted for the toughest-yet air pollution bill, 73 to 0.

But there shouldn't be a Clean Air Car Race for long. As committee chief Bob McGregor aptly put it, "If they're still running Clean Air Car Races in 1980, it will mean we failed in 1970."

Caltech's '70 Hornet (above) ran on liquid natural gas. Backers of New Hampshire's electric (right) couldn't afford body. It was pushed across finish.

Water cascades and terraces overlap in Portland's new "liquid sculpture" by Lawrence Halprin. Inspired by mountain rivers, it not only looks good but is good for people to splash around in.

By Wolf Von Eckardt

A beautiful plaza, designed for fun

Lawrence Halprin's Portland masterpiece, shopping malls and garden communities reflect his belief that nothing should be static

Shortly after Lawrence Halprin's waterfall fountain in Portland, Oregon, first started gushing, roaring and splashing last June, a 48-year-old lady tourist from California came to take a quick look. "I could not resist putting my toe in," she recalled. "And I was lost. I had to get in and up those water steps—dress, nylons, who cares? What a feeling! What freedom!"

Her experience, which in one way or another is shared by hundreds of people of all kinds and ages every day, pleases Halprin as much as the rave review that Ada Louise Huxtable, architecture critic of the *New York Times,* gave his waterfall plaza, officially known as the Auditorium Forecourt. "One of the most important urban spaces since the Renaissance," she called it. What makes it important, she explained, is that like, say, the Fontana dei Trevi in Rome, it invites people to get involved, to get wet, to immerse themselves in the glory of art and life, as it were.

This is no accident. It is very much the intent of Halprin's design. The Portland waterfall is an ingenious concrete sculpture that lets the water cascade in various ways some 18 feet into a pool, where platform islands form the stage of an amphitheater. It is the main element of a "people's plaza" that takes up a city block and affords visitors almost endless opportunities for participation. For centuries we have used public spaces to impress the populace with the greater glory of something or other (God, the state, or a bank) and Keep off the Grass. Halprin would make public space a place where people can express their feelings.

Architecture critic Wolf Von Eckardt was formerly with the AIA Journal *and is the author of* A Place to Live: The Crisis of the Cities.
Color photographs are by Robert W. Kelley.

Lawrence Halprin is a landscape architect in his early 50s who, like many of his colleagues, is equally concerned with the cityscape. He comes from New York City, Cornell and Harvard (with a detour of some years in a Palestine kibbutz), but has his main office in an old warehouse in San Francisco. His latest book develops a highly sophisticated system of charting "Creative Processes in the Human Environment," but he chooses to look like a lumberjack. He never goes anywhere without his sketchbook.

Into that sketchbook goes a constant stream of observations and perceptions. Out of it come some unlikely ideas that nevertheless seem more likely to make our cities human and livable than do many of the sociological studies and technological schemes being bandied about these days. No sociologist, engineer or urbanologist would have thought of re-creating cascading mountain streams in downtown Portland (he also designed a smaller but similar waterfall at nearby Lovejoy Plaza), and Halprin's design was preceded by hundreds of sketches of natural waterfalls in the Sierras.

Some other unlikely ideas include developing a seashore resort, The Sea Ranch in northern California, for private profit, yet leaving two-thirds of the land untouched wilderness; turning the charming old Ghirardelli chocolate factory in San Francisco into a sophisticated but bustling shopping center; or making an eight-block-long pedestrian mall out of Nicollet Avenue in downtown Minneapolis.

They are the ideas of an artist but they have proved to be stunningly commonsensical. They all impart an experience, probably because they are essentially born out of Halprin's own intense experiences, distilled in that sketchbook (he spent weeks camping in the Sea Ranch wilderness to learn about its ecology).

The formula of Halprin's success, it seems to me, is that he *has* no formula—no style, no preconceived notion of what a plaza, a shopping center, a neighborhood, a new town or a city ought to be. These things, he believes, should never be static; they ought always to be in motion, growing, changing. His wife, Ann Halprin, is a dancer and choreographer, and her art has had considerable influence on his.

The influence of dance and of theater on his thinking has probably led him to what I consider his most important contribution to urban design. He does not put his emphasis on things, such as buildings, but on people in relation to these things. Those fountains in Portland, or Ghirardelli Square, or his proposed revision of some dismal urban renewal projects in New York, choreograph the way people move between and perceive and act on and react to things that make up the urban stage set. And, most of all, the way they have fun.

At night, lights add a flickering dimension
of color. Fountain faces Portland's Auditorium.

Halprin shows his ebullient nature as he exults at dedication ceremonies for his fountain.

Seen dimly through sheets of water, fountain climbers perch on a ledge behind the falls.

A stream of steps is an invitation to play which young and agile happily accept.

By Dale F. Dickinson

Radio astronomy opens wider windows on space

A rich primordial soup of atoms and molecules sends us information through space about where we are and how we came to be here

After thousands of years in which all that man knew about the heavens he learned by visible light, radio astronomy has opened a much wider window on the universe. The ancients observed the constellations with the naked eye and used them to navigate across steppes and seas. Galileo's telescope revealed many finer details, such as moons among the planets. In this century giant instruments have shown us the structure of distant galaxies.

Yet all of these observations made use of only the tiny portion of the electromagnetic spectrum that the eye can see. Radio astronomy detects wavelengths and frequencies far outside this range and, because atoms and molecules broadcast much of their information in the radio spectrum, it brings us fascinating information about the makeup of our own galaxy, the Milky Way.

The science was born in 1931 when Karl Jansky,

Mosaic photograph shows part of Milky Way,
the galaxy of which we are a part.
Arrow indicates Lagoon Nebula (see next page).

a young Bell Telephone engineer, accidentally detected random radio emission ("noise") from cosmic sources. Transatlantic radiotelephones were being developed at that time, and Jansky's job was to investigate noise from thunderstorms that might affect such phone calls. He soon observed that a part of the noise could not be attributed to storms, receiver problems or any other known interference. The way it rose and fell in a regular period of about 24 hours indicated an origin well beyond the earth.

Further investigation showed that it came from a part of the heavens in the direction of the constellation Sagittarius—a region that we now know is the center of the Milky Way. If distant stars were responsible for the radiation, then our own sun should also have been observable at radio frequencies. Since it was not, Jansky concluded—quite correctly—that this radiation came from interstellar matter. This dilute gas and dust in space among the stars is now known as the "interstellar medium," and is one of the principal domains of radio astronomical investigation.

In the 1930s electrical engineers had less professional communication with astronomers than they have now, and few persons appreciated Jansky's pioneering work until 1937. Grote Reber, a young radio engineer, then became interested in it and set about assembling a radio telescope. In his antenna he used a 31-foot parabolic reflector, the first of a kind that has since become familiar. The instrument was, quite literally, a backyard project at Reber's home in Wheaton, Illinois. It was sophisticated for its time

The author is a physicist with the radio-astronomy program at the Smithsonian Astrophysical Observatory in Cambridge, Massachusetts. He is studying spectral-line emissions and hydroxyl maser actions.

and soon yielded the first radio maps of the heavens at a frequency near that of today's commercial television stations.

Reber submitted his results to the *Astrophysical Journal* where, initially, no one was willing to pass judgment on the acceptability of the paper for publication. Thus, some years after Jansky's discovery of cosmic radio waves, the infant science was still suffering from nonexposure. Fortunately, however, the journal's editors finally decided to publish Reber's sky survey, and it appeared before the astronomical community in June 1940.

The war that was then enveloping Europe caused further delay in finding an audience for the new science. However, the microwave technology developed during World War II for radar and communications proved enormously helpful to radio astronomy in the postwar period. And one of the most important theoretical contributions to the field was made during the war in Nazi-occupied Holland. A copy of the *Astrophysical Journal* containing Reber's article eventually reached the observatory at Leiden, where Jan Oort, the director, read it with great interest. His student, Hendrik van de Hulst, subsequently suggested that atomic hydrogen might be observed in the interstellar medium by its characteristic radio-frequency transition at a wavelength of 21 centimeters (a frequency of about 1,420 million cycles per second). His prediction was verified when H. I. Ewen and E. M. Purcell of Harvard detected the 21-centimeter line in 1951. Observation of interstellar hydrogen then became the principal area of radio astronomical investigation during the 1950s.

Early findings, like those of Reber, were what radio astronomers call "continuum" observations. Continuum radiation extends over a broad range of frequencies. By scanning a region with the telescope and plotting the energy contours, a radio astronomer can infer much about the astrophysics of that region. There is also another type of radiation, however, that is called "spectral-line" or "line" radiation.

Quantum theory has shown us that atoms and molecules exist in a hierarchy of energy levels that differ from one another by fixed and definite amounts. When a particular atom or molecule makes a transition from one energy level to a lower one, the difference in energy departs as a bit of electromagnetic radiation called a "quantum." Any quantum possesses a unique frequency that is directly proportional to the size of the energy step. When many such quanta are radiated, the intensity of radiation at that frequency can be many times as great as the thermal intensities at nearby frequencies. This increased intensity is called a "spectral line."

Astronomers are interested in spectral-line observations because they contain important astrophysical information not found in recordings of continuum radiation. Every atomic or molecular species has its own structure, and detection of a particular frequency enables a scientist to identify not only the substance but also the energy states involved in producing its radiation. The intensity of a line can then be used to infer the density and distribution of the substance that produces it.

Doppler shifts (named after a 19th-century physicist) denote a change in the observed frequency produced by the motion of the substance. When a car passes with horn blowing, the Doppler shift is responsible for the change in pitch of the sound you hear. This occurs because when the car is approaching, the wave crests of the sound reach the hearer at a frequency greater than when it is receding. The same phenomenon occurs in electromagnetic waves and provides an accurate measure of the velocity of the signal source with respect to the earth. Although this effect is minute (amounting perhaps to a shift of one part in 10,000), it indicates the motion of a radiating gas cloud. Moreover it can be measured so accurately that it shows small variations in the velocity caused by turbulent motions within the cloud. This internal motion tends to spread the frequency width of the spectral line in a manner proportional to the degree of turbulence.

Our own island in the sky

Thus line radiation can be a very powerful aid to astronomical research, and when the 21-centimeter hydrogen line was found, astronomers quickly put this new knowledge to use. This line still is the most effective for galactic exploration.

One of the successes of 21-centimeter work has been the delineation of the large-scale structure of our galaxy, the Milky Way. Astronomers as far back as the 18th century suspected that the heavens were far from random in their order. Sir William Herschel, who was then Astronomer Royal at Greenwich, was an early proponent of the "island-universe" theory. He regarded the belt of starlight in our sky as a system of related gas and stars that included our sun and its planets, and he speculated that the other nebulae that he saw were distant islands of stars and gaseous matter similar to our own Milky Way. He was right, of course, but his ideas were not verified

The Lagoon Nebula, 4,000 light-years away, as photographed with visible light. Radio astronomy shows it is rich in ionized hydrogen.

until a century after his death. In 1924 Edwin Hubble found that he could observe individual stars in the Andromeda Nebula, which is the closest to our nebula. Some of these stars were variables called Cepheid, a type whose periodic fluctuations tell us the star's absolute brightness. With that number in hand, calculating the distance from the apparent brightness is a trivial problem, and Dr. Hubble demonstrated conclusively that Andromeda was a galaxy, separate from our own and far more distant than was previously imagined.

With this island-universe idea established, astronomers began the task of describing our own galaxy in greater detail. Optical observers were handicapped by dust clouds in it which tend to obscure details, particularly in the central regions. At the longer radio wavelengths the Milky Way is more transparent, permitting observers to investigate its farthest reaches by mapping the distribution of hydrogen gas.

Radio astronomers in Holland were among the first to undertake a large-scale galactic structure project. By 1958 they had completed a survey covering the plane of the Milky Way as far as it is visible in the northern hemisphere. This work is still an important reference. Not long afterwards, Australian observers filled in the missing segment, and the two together gave us a striking picture of the form and structure of our galaxy.

We know now that the Milky Way is a large, flattened disk about 100,000 light-years in diameter. The plane of this disk is formed by lanes of stars, dust and gas that spiral outward from the center. If you could view the whole system from above, it would look like a giant celestial pinwheel. The Andromeda Galaxy, which is about two million light-years distant, also has a spiral structure, and a picture of it suggests how our own galaxy might look from afar. It appears elliptical, but this shape merely reflects the tilt of the galaxy as viewed from our earth.

When we peer into the night sky at the Milky Way, we are looking through the galactic plane at the principal concentration of stellar matter. Above the plane the night sky is noticeably blacker, with fewer stars, and we see none of the haze we associate with the Milky Way.

And where within this picture do we reside? Our solar system is located on the edge of a spiral arm in a region of low stellar density, about two-thirds of the way from the center of the galaxy toward the rim. In astronomer Carl Sagan's succinct phrase, "We are in the galactic boondocks."

The gas and dust of the plane are, undoubtedly, the seedbed from which new stars are formed. Radio mapping of the Milky Way has broadly confirmed this by showing the strong correlation between the spiral arms and the distribution of hot, blue stars. These huge stars, some 40 or 50 times the mass of our sun, are known to be quite young (by the standards of astronomical time) because they burn themselves out very quickly. They are located, with few exceptions, in the dusty, gaseous regions of our galaxy's spiral arms.

For many years the 21-centimeter spectral line of hydrogen was the only one that radio astronomers had to help them. Oxygen, carbon and nitrogen are abundant elements, but they have no readily distinguishable spectral lines lying in the low-frequency radio domain. The next choice was to consider simple molecules involving those elements. Even among such molecules, it was felt, few would be sufficiently abundant to be detectable by radio telescopes.

Astrochemical information explodes

The leading candidate was the OH (hydroxyl) molecule. It is a simple diatomic substance with four radio lines known from laboratory spectroscopy, all lying near the hydrogen line in frequency. Several observatories searched for this molecule without success until 1963. By then a new generation of improved receivers had come into broad use. The first detection of OH came from the direction of the constellation Cassiopeia, and it was subsequently seen in several dozen other radio regions of the Milky Way.

This discovery was a major advance. The OH observations provided radio astronomers with some indication of the abundance of interstellar oxygen and the chemistry involved in the formation of molecules in space. In other words, they gave us an independent new look at the astrophysics of the interstellar medium. OH was not so widely distributed as hydrogen, and thus offered a more selective

Karl Jansky of Bell Telephone Laboratories shows where, in 1931, he first found radio noise in space. He was studying radio interference.

view of those regions in which it was concentrated.

Within the past two years, a sort of "astrochemical" information explosion has occurred. Radio astronomers have detected ammonia, water vapor, formaldehyde, carbon monoxide, cyanide, hydrogen cyanide and cyanoacetylene in the interstellar medium.

The first of these molecules to be found was ammonia (NH_3) in cool clouds near the center of our galaxy. This came about when Nobel physicist Charles Townes and his associates at Berkeley constructed a receiver for operation at 1.35 centimeters, a region of the spectrum that had not been intensively studied before. Shortly thereafter, the Townes group tuned their receiver from the frequency of ammonia to the nearby frequency of water vapor—and observed the strongest radio emission lines ever seen in the heavens.

Observations of ammonia and water were exciting discoveries, and very useful from an astrophysical standpoint. The experiment that blew the lid off the interstellar-molecule business, however, was the detection of formaldehyde (H_2CO) in early 1969. After years of observing only hydrogen and the hydroxyl molecule, the appearance of formaldehyde gave tremendous impetus to interstellar molecule hunting. Radio astronomers, thumbing their old chemistry texts as rapidly as they could dust them off, soon took note of the region of the radio spectrum around three millimeters—which is rich in molecular transitions.

Spectral-line receivers to operate at the three millimeter wavelength had to be built from scratch, and the building took time. The results, however, are already quite impressive: A team of Bell Telephone Laboratories physicists including Robert Wilson, Keith Jefferts and Arno Penzias found carbon monoxide (CO) and the cyanide radical (CN) in several radio sources of our galaxy last spring. Immediately after their work, Lewis Snyder and David Buhl of the National Radio Astronomy Observatory, found hydrogen cyanide (HCN) at a slightly lower frequency. And the most complex molecule observed thus far, cyanoacetylene (C_3HN), was reported only this August by their colleague Barry Turner.

Thus, in the last couple of years, we have learned that chemical evolution in the interstellar medium is considerably more complex than was previously suspected. Each newly found molecular spectral line has been another piece in the jigsaw puzzle of densities, temperatures and collision rates that govern the formation of molecules in space.

Complex molecules and space masers

The presence of water and the four organic (carbon-bearing) molecules is especially interesting to students of the evolution of life. Ammonia (NH_3) is also intriguing in this regard because of the importance of the amino group (NH_2) in the chemistry of proteins. Surely other substances will be detected in the next few years. Several more molecules probably exist in substantial abundance in the interstellar medium.

The wait for more discoveries, in fact, may not be long. The Germans have nearly completed their huge antenna at Bonn, with which they may well overcome the early lead of the United States in interstellar chemistry and radio astronomy.

One of the startling findings of interstellar-molecule observers is that certain substances apparently radiate like those in laboratory masers. These man-made devices produce intense radiation at particular frequencies. Moreover their radiation is coherent; each atom or molecule that adds a quantum to the

beam does so in such a way that its radiation is in step with the radiation that is already there. The effect is as if many children, making waves with boards in a swimming pool, synchronized their movements to make a single giant set of waves. (A laser is just like a maser except that the laser operates at light frequencies whereas the maser produces radio frequencies.)

To make a laser or maser work, one must selectively populate an energy level so that many more atoms or molecules are in this state than is normally the case. This process is called inversion.

When a molecule drops from the overpopulated level to a lower one, the energy difference is radiated away, further inducing other excited molecules to radiate. The resulting intensity buildup produces a very strong spectral line in contrast to the broad continuum radiation of thermal emitters.

The hydroxyl molecule and water are remarkably powerful in interstellar masers. OH was first detected in maser emission in 1965 by Harold Weaver and his group at Berkeley. They were reluctant, at first, to identify their discovery as the hydroxyl molecule because of its extraordinary intensity, which was totally unexpected. However, the intensity and other properties that are characteristic of terrestrial masers soon established the maser idea as the dominant explanation.

A fascinating astrophysical question now is: How does nature turn a cold interstellar gas cloud into a maser? From laboratory work we know that population inversions can occur through collisions between molecules and atoms or by optical excitation; that is to say, by the absorption of radiant energy from a nearby source. Since most of the OH and H_2O masers found by radio astronomers are near the plane of our galaxy, they may be pumped up by intense ultraviolet light of recently formed hot stars there, or perhaps by infrared radiation from cooler stars and gaseous nebulae. The problem is complex; a definitive explanation will be a long time coming.

One of the most intriguing topics for scientific speculation these days is the question of life on other worlds. What we have learned in recent years suggests that we are probably not alone. From the astronomical side, we can make a coherent if qualitative description of how the stage is set for life to begin. We have seen that the Milky Way is rich in gas and cosmic dust, and that new stars form there as a result of gravitational contraction when matter becomes sufficiently dense.

The stars of our galactic plane contain heavy elements and molecules, and radio astronomy has now shown us that the process by which molecules are formed gets well under way even in the dilute clouds of the interstellar medium. The molecules that we have identified thus far are composed of hydrogen, oxygen, carbon and nitrogen. These elements are among the most abundant on earth and are the principal constituents of proteins and nucleic acids. The radio astronomical detection of HCN (hydrogen cyanide) is especially notable because this molecule is thought to be extremely important in the synthesis of certain amino acids, such as glycine and aspartic acid, as well as in the formation of compounds essential to the nucleic acids. Clearly, nature fashioned plants and animals from readily available materials.

Does space have other life?

Although simple organic compounds and related molecules may be formed in interstellar space, the life cycle of even the simplest organism obviously needs a more hospitable environment—a stable star for an energy source and a planetary home. Even with the most powerful telescope, we still cannot see planets around any of the nearby stars, but there now is indirect evidence that several of our stellar neighbors *do* have planetary systems. Indeed, in the 100 billion or so stars of the Milky Way, planetary systems must be fairly common.

The atmosphere of a primordial planet would be rich in ammonia, methane, hydrogen and water. The geologic record shows that these gases were prime components of the early atmosphere of the earth, and they would be the ingredients for a rich organic soup; all that would be needed in addition would be a reasonable temperature. Then chemical evolution could begin its billion-year journey toward the first forms of living matter.

From this brief sketch, you can see why scientists in many disciplines now feel a sense of frustrated

certainty—the "I know it's true, but can't prove it" feeling. Radio astronomers may be more eager than most people; almost certainly the first contact with civilizations elsewhere in our own galaxy will occur by radio. The technology for cheap and effective communication with other solar systems already exists—if only we knew who might be sending and who might be listening.

Of all the fascinating aspects of radio astronomy, perhaps the speculation about life on other worlds is most stimulating. Technological earthman is only a couple of hundred years old, a newcomer in a galaxy that may be ten billion years old. Statistically it seems certain that other beings have had the intellect and manual dexterity to develop a technology like ours. So we should not be too surprised if the first message our radio telescopes bring us says, "Welcome to the network. Following is a list of communication frequencies for 47 civilizations in your immediate stellar neighborhood. . . ."

Signals received by this 84-foot antenna contribute to the program shared by the Smithsonian Astrophysical Observatory and Harvard University.

By Meryle Secrest

Kenneth Clark: definer and defender of the values of civilization

A film series now being shown on public television is turning this urbane and erudite art critic into a popular culture hero

One sees him in the mind's eye, perhaps standing on a staircase and leaning slightly backwards, framed by some celestial ceiling. Let's say it is the staircase of the Bishop's Palace in Würzburg. Above him swirl the extravagant outpourings of Tiepolo's imagination: puff-sleeved musicians brandishing fiddles; cloaked figures reeling across the improbable landscape; a confusion of dogs, ostriches, goddesses and feather headdresses.

This is the Kenneth Clark (opposite, in his garden) of *Civilisation,* the 13-part film series he wrote and narrated for BBC television *(Civilisation,* British spelling intact, has now crossed the Atlantic: the films have been seen by audiences in Washington, New York and other cities, and are now being shown on public television stations across the country as a result of a grant from the Xerox Corporation; a book based on the scripts was published in this country early last spring.)

The spectacular setting of the Würzburg Residenz is perhaps more in keeping with his new role as a TV celebrity than the role for which he was, until now, better known—that of writer and critic. Clark's books, such as *Landscape into Art* and *The Nude,* have become modern classics as much for the clarity, economy and elegance of his language as for his insights into the nature of art. One hesitates to see the vividness of the TV image menaced by the slightest contact with reality, yet the prospect of stepping into—or out of—the picture oneself is too tempting.

So I find myself on the train bound for Folkestone, near the little village of Hythe where Lord and Lady Clark live in Saltwood Castle when he is not in London, or traveling around Europe making films, or giving lectures and accepting honorary degrees.

In the films a precise picture emerges of a man in his 60s dressed in conservatively elegant clothes, still handsome, with a beautifully shaped head, even features and a freckled Scottish complexion. He gestures rarely in these films. When his hands do move. they seem to be escaping despite his will. But his face is alive with a constant play of expressions which move over it like cloud shadows across a field. What endears him most to the viewer, though, is his enthusiasm. One has seldom seen a man more calmly confident or better able to forge, out of the muddle of the centuries, a great and noble outline.

He said in a speech: "I suppose that all examinations of the human spirit are defeated at about the same point; and when this point is reached, there is only one thing for the critic-analyst to do; and that is to change sides. He must himself become an artist."

This rare ability to interpret and communicate must explain why Lord Clark has become the culture hero of the middle classes, I tell myself as the train arrives at Folkestone five minutes early. (Ah, the splendor of a civilization that can make the trains run *ahead* of time.) He is already waiting at the foot of the steps. Quite as I thought. The man has stepped out of the framework without ruffling a hair on his head. He smiles the smile I have come to know through the *Civilisation* films, adjusts a green velour hat to a jaunty angle that sets off his profile, and we splash out into the English summer rain.

Meryle Secrest regularly writes on cultural matters for the 'Style' section of the Washington Post.

Kenneth Clark on civilization

He drives a 10-year-old Wolsey with a gray exterior and a handsome red leather interior which, he says, his children think is not grand enough. He likes it, and one can see why. Even the clock works, and the odometer reads 6,114 miles. There are two books in the glove compartment: *Charles Darwin and His World* and *The Odes of Pindar.*

The rain beats against the windshield. "This is what my father used to call a beezer," he says of the storm. We are waiting for Lady Clark to come out of Miss Dora Clifford's, the hairdresser. Time for a quick one. We drive up to Folkestone's largest hotel, grandly leaving the Wolsey in front of the steps. A couple of gin-and-tonics later, when we return to the car, his seat is soaked with rain because he has left the window open. "Oh well," he says, "I shall get a wet bottom," and we drive off.

Saltwood is a real castle. Some parts go back to the fourth century A.D., and others have been added ever since. There is a Great Hall, where Lord Clark studies, at the end of the garden, beside a ruined Roman wall. There is a high wall encircling a soft green meadow where the grass is kept so trimmed that the daisies have learned to grow only a quarter of an inch high.

It is a castle out of Walter Scott, with gray turrets and ivy creeping over the walls and flowers planted in the cracks of the stone steps leading up to the door. Inside, one gets a blurred impression of walls crammed with oils, drawings, water colors: Henry Moore, Graham Sutherland, Cézanne; sculpture, wood paneling, vast looming bookshelves, fringed and tasseled pillows, bouquets of white daisies and sweet peas, mullioned stained-glass windows.

During lunch (lamb with mint sauce in a silver bowl, raspberries and cream, Chinese porcelain) Lady Clark sits saying very little, smiling gently. There is talk about a duchess who won't open her house to the public, even if she is only in it six weeks of the year. Lord Clark keeps urging food on the guests. He serves us from a side buffet until Lady Clark says companionably, "Do sit down now, K," and gives him a gentle, abstracted smile.

Lord Clark's day at Saltwood Castle is parceled out into alternating intervals of work, rest and contemplation. He works from 10 until 11 a.m., then takes a walk with Lady Clark into the woods. He works for another hour, 12 to 1 p.m., stops for lunch, and takes an afternoon nap. More work from 5:15 p.m. until 8: "The only good ideas I have come then." He has a drink at 6, finding that it releases his imaginative faculties. Then dinner. He never works afterwards, because it keeps him awake, preferring to watch television.

Clark is a richly complex person, confident at times, diffident and insecure at others. He can be outspokenly frank and modest to the point of self-abnegation. He is in fact an activist, but one with a deeply meditative and philosophical imagination. Behind his abundant drive and vigorous engagement with great events, there is a streak of melancholy. One of his favorite quotations is "Look thy last on all things lovely every hour" (Walter de la Mare).

He was an only child. The first 15 years of his life were spent in a 25-bedroom house in Suffolk, Sudbourne Hall. He says: "My father's only ambition was to be a sportsman. He loved racing yachts. He inherited money from his father and speculated a great deal. They were really the idle rich. They could barely bring themselves to sign their own names." His parents would arrive from Scotland in time for the first of October, when pheasant shooting begins, and leave for Monte Carlo around January 10. So he stayed alone at Sudbourne Hall for most of the year.

In an autobiographical fragment called *The Other Side of the Alde,* he has written: "I should have felt lonely, but in fact I do not remember suffering any inconvenience from solitude. . . . I would be delighted to get back to my large empty house, to the library, the billiard table and the pianola. . . . My parents had decided that I should not learn to play the piano, as they thought, quite correctly, that the sound of my practising would annoy them. But by means of buying scores and propping them up on the pianola while I played, I enjoyed the illusion of learning without pain. . . . Chopin was my god, and as I pedaled away at one of his *Ballades* tears would pour down my cheeks."

His father raised champion draft horses of a breed known as Suffolk Punches. "I think that Suffolk Punches provided my earliest experience of sculptural beauty," he says in *The Other Side of the Alde.* "The memory of their full, compact shapes and silky brown surfaces, which I recover every time I open a horse chestnut, may still underlie my artistic judgments."

Looking back on his life at Sudbourne Hall, he says: "I do not complain of the rich, sporting, philistine atmosphere in which I was brought up. I can think of many other milieus—clerical, academic or military—in which I should have been far less happy. But from an early age I know that the only society I enjoyed was the society of artists, the society of people whose minds were free, whose senses were alert, and who felt the need to communicate their joy."

At the age of 10 he decided to become a painter; he worked at it very industriously and won some prizes, but early recognized that he was inhibited by certain qualities of his character. Then, he says, "I won a history prize and that started me on *that* course. I got a scholarship to Oxford to the great surprise of everybody. From that moment on I thought, if an Englishman can paint a bit and write a bit, he had better take up writing."

There were no degrees given in art history in those

Among landmarks of art—and civilization—that Clark mentions are Giotto's development of naturalism, as seen in his *Lamentation* (above), and the invention of realistic portraiture in Flanders, exemplified by Jan van Eyck's *Arnolfini and his Wife* (opposite).

Clark calls Erasmus (above, by Holbein) "the first man to take full advantage of the printing press."

days, so Clark launched into a process of intense self-education that he now describes most casually: "I picked it up in a desultory way." He also began to forge the beliefs about art which he has elaborated on ever since. In a 1951 inaugural speech as president of the Associated Societies of Edinburgh University, he said: "All great art is religious." This emphasis on the transcendental nature of great art turns up again and again in his work. In *Civilisation,* discussing Michelangelo's figures for the unfinished tomb of Pope Julius II, Clark says, "One feels that they express Michelangelo's deepest preoccupation: the struggle of the soul to free itself from matter." And as an epigraph to his brilliant study of *The Nude,* he uses a quotation from Spenser: "For soule is forme, and doth the bodie make."

The influence of Ruskin and Berenson

Clark also discovered Ruskin, the 19th-century philosopher of art, architecture, society and nature, whose collected writings run to 39 volumes. Six years ago, Clark published an anthology entitled *Ruskin Today* in an attempt to restore that neglected author's work to critical favor. There he cites Ruskin's belief that the greatest artists were attempting to convey truths about life; he thought that "great art is the expression of epochs where people are united by a common faith . . . and take a serious view of human destiny."

Another early influence on Clark's life was Bernard Berenson. "It's a curious story," he says. "I must go back to the age of 16 when I was at Winchester and walking back from chapel. The boy I was with asked me what I wanted to do when I grew up, and I said I'd like to help Mr. Berenson do a new edition of his *Drawings of the Florentine Painters.* My housemaster overheard and was furious. He thought it was the pretentious statement of a beastly little prig.

"At any rate, I had lunch with Berenson when I was 19 or 20. He made an extraordinarily unpleasant impression on me. He seemed arrogant and contemptuous. He spoke ill of people. Finally he left on a trip, surrounded by fawning servants and driving off in a large Lancia. As he reached the door, he turned around and suggested that I help him do a new edition of the Florentine drawings. I thought it so strange that I had a temperature—getting what one wants can do that to you.

"I got to like him in the end, but only after 1930, after the slump. He had lost his powers and become more human. He had a wonderful historical mind. He was a prodigiously intelligent man, but this intelligence was vitiated by vanity and arrogance. I don't think he liked me much either; what he liked was the well-born attentive."

Then Kenneth Clark went away and got married, "which annoyed Berenson very much." His wife Jane was also an undergraduate at Oxford, studying philosophy, politics and economics. He had a chance to become Keeper of the Department of Fine Art at the Ashmolean Museum at Oxford. "I took it on partly because I liked it and partly because it made it easier for my parents. When they were asked what I was doing, they didn't have to say 'Nothing.' "

In 1933, when he was 30, Clark was asked to become Director of the National Gallery in London, a post he held until 1945. He says now: "It was a great mistake. Although I might have had quite a good eye for buying paintings, I'd had absolutely no practice in dealing with people. I'd led rather a solitary life, and I didn't know when to give them their head and when to tell them to go to blazes." He still seems to be angry with himself for having taken the post.

In those days he collected a great deal of art. Now he says the desire has entirely left him, except for buying an occasional print. "I bought Henry Moores from the start. He has been a friend of ours since 1932. It's true that I can't advance much beyond Jasper Johns and Rauschenberg. I am not at all good at hard-edge abstraction."

Clark has been criticized for the scant recognition he gives to contemporary art in *Civilisation.* John Russell, the British art critic, accuses Clark of being "a static elitist aesthetician" who can only look backwards into a glorious past, where all great achievements have been accomplished, and who sees nothing of value in 20th-century art, music and architecture. Wylie Sypher, in another review of the book version of *Civilisation,* made up of the scripts written for the film series, said: "The trouble is that while Lord Clark rejects 'a stationary perfection,' he dreads a disruptive art. He wants civilization to change, but without rev-

olution. Yet the history of the arts—especially the modern arts—is prevailingly revolutionary, and revolution is always a break with the immediate past."

Clark denies that he rejects modern art altogether. He says in a letter: "I think art must recover some correlation between the visible world and the artist's interior world. But this doesn't rule out abstraction. I greatly admire Mondrian, but then I am quite sure that his abstractions developed inevitably out of his visual experience. I am not so sure about some of the American hard-edge painters. But I have seen pictures by Roy Lichtenstein that were powerfully designed and even imaginative. I'm afraid a painter or sculptor must have some way of making memorable shapes out of experiences; if he has, it will be apparent whatever style he adopts—or not."

A nation writes its autobiography

Civilization depends, Clark believes, on man's extending his powers of mind and spirit to the utmost. At the very beginning of the film series he quotes Ruskin: "Great nations write their autobiographies in three manuscripts, the book of their deeds, the book of their words and the book of their art. Not one of these books can be understood unless we read the two others, but of the three the only trustworthy one is the last."

He adds, during our talk, "There can be a very high degree of development in art and architecture, and a lot of inhumanity among the people in control. You have to distinguish between the politicians and what used to be called the finer spirits of the age."

Returning to London late in the afternoon, I realized that Lord Clark had left more unsaid than said. What of all those other achievements in his life—in the Ministry of Information during the war, setting up the postwar Arts Council of Great Britain, acting as first chairman of the Independent Television Authority? What about the books on Piero della Francesca, Leonardo da Vinci, *The Nude, Rembrandt and the Italian Renaissance, The Gothic Revival* and *Landscape into Art?*

But perhaps I have learned as much about the manner in which he has lived as I need to know. As we drive to the station he is talking about the projects he is working on: a film about the Norwegian artist Edvard Munch, with his son Colin as director; a collected volume of his writings; a full autobiography.

"To write it chronologically," he tells me, "would be tiresome. But I think if I did it in a series of chapters on subjects—one on the making of an aesthete, one on English society in the '30s, one on Berenson—then I wouldn't be just pounding out anecdotes. It would make the book more like a work of art."

Tours for Associates

The foreign study tours listed below are currently being planned exclusively for members of the Smithsonian Associates. Members wishing further information should write: Smithsonian Reception Center, Great Hall, Smithsonian Building, Washington, D.C. 20560, specifying which tours are of interest.

Yucatán Peninsula and Mexico City: A one-week tour of Mayan archaeological sites in Yucatán, including Mérida, Chichén Itzá and Uxmal, followed by visits to museums and other cultural attractions in Oaxaca and Mexico City. Second week in December. Dr. Richard Howland of the Smithsonian staff will conduct.

Opera in Italy and Sicilian Archaeology: A combination tour offering good seats and backstage visits to the opera houses of Rome, Milan, Naples, Venice, Trieste, Catania and Palermo, and an introduction to the Greek archaeological sites of Sicily. Mrs. Loudon Mellen of the Washington Opera Society and Dr. Richard Howland, Smithsonian staff, will conduct. Leaves mid-February 1971, for three weeks.

East African Safari and Indian Ocean Cruise: A five-day visit to the great game preserves of Kenya and Tanzania, followed by a two-week cruise to Aldabra and others of the Seychelles island group from and to Mombasa. Dr. George Watson, chairman of the Department of Vertebrate Zoology at the Smithsonian's Museum of Natural History, will conduct—March 20 to April 15, 1971.

Asiatic Turkey: A tour of Hittite archaeological sites in central Turkey and the better-known classical excavations in western and southern Turkey. The itinerary will be planned for short trips out of Ankara, Alanya and Izmir, with comfortable hotel accommodations. Mr. John J. Slocum, on Smithsonian's Museum of History and Technology staff and a trustee of the Archaeological Institute of America, will conduct. The tour is planned for the late spring of 1971.

Palladian Architecture in Ireland: Visits to private estates and public buildings, with seminars on preservation techniques and methods, in cooperation with the Irish Georgian Society. Dr. Richard Howland of the Smithsonian and the Honorable Desmond Guiness of the Irish Georgian Society will conduct—May 31 to June 15, 1971.

South America: A 25-day tour of Venezuela, Colombia, Ecuador, Peru and Brazil, with emphasis on archaeological sites, colonial and contemporary architecture, museums and private collections, including a short visit to the upper Amazon basin. The tour is planned for August 1971.

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Book review

René Dubos of Rockefeller University (see SMITHSONIAN, *April 1970) finds Loren Eiseley's new book helps Man recapture his cosmic sense*

I have read most of Loren Eiseley's books, each of them at least twice and with much the same reaction. On first reading, I tend to be somewhat impatient because I do not perceive a unifying theme in the book and find it difficult to recognize solid information. But I am never bored.

Within a few minutes, I am bewitched by the style which is often that of a poet and not uncommonly that of a seer and prophet. Each paragraph gives me a vivid, unexpected image, usually so personal that I see the author reflecting and brooding as he turns in his hands the cranium of a Stone-Age man, ponders over the hidden meaning of some human artifact, or encounters—in imagination if not in reality—a ghost from his own past.

Loren Eiseley's style and images create a mood of awe and wonderment which fits his approach to the human condition. If the themes of his books appear diffuse, it is because they never deal simply with man in the here and now, but rather with man's relationships to the immensity of time and space.

The theme of *The Invisible Pyramid* (Scribners, $6.95) is especially complex because it includes an acknowledgment of uncertainties concerning man's origins, a statement of his limitations, and a forecast of his self-destruction unless he finds a way to reenter the world of nature which brought him into being.

Like Lewis Mumford in *The Myth of the Machine,* Loren Eiseley rejects the theory that use of tools has been crucial to man's development. For several million years, our man-ape ancestors flourished on earth with a very small brain; they used stones and bones and fashioned crude windbreaks as far back as two million years ago.

The expansion of the neurocranium took place rather suddenly during the Ice Age, but there is no evidence that this was caused by an increased use of tools. That man has utilized tools throughout his history is obvious, but it is equally true that living primitives, such as the Australian aborigines, have achieved complex languages and a high level of social organization without showing any technological inventiveness.

Toward the end of the Ice Age, many big mammals disappeared from the earth—mammoth, mastodon, sloth, long-horned bison—whereas man survived and flourished. Eiseley suggests that this curious situation may be accounted for by a startling hypothesis: a giant solar flare occurred some 30,000 years ago. This solar flare would be the star dragon's breath of ancient legend. It appears certain in any case that, along with the growing desiccation of Southeast Asia, the extinction of the large fauna at the end of the Ice Age gave man, the hunter, "a mighty push outside his game-filled Eden." He had to turn to plant domestication to survive. "The women with their digging sticks and arcane knowledge of seeds" may then have become the chief providers of food.

"The spring and harvest festivals began to replace the memory of the 'gods with the wet nose,' the bison gods of the earlier free-roving years." Whatever really happened, man's world was irreversibly changed when he had to abandon the hunter-gatherer way of life. "Perhaps there is something after all to the story of his eviction from the green Garden. . . . Men have long memories when the memories are clothed in myth."

Men have exploited the Earth since the beginning of time. In Eiseley's words, they have increasingly become "world eaters." Human life is now completely dependent on natural resources which are limited and not renewable. "If, after the crust of the earth has been rifled and its resources consumed, civilization were to come upon evil times, man would have to start over with incredibly less than lay potentially before the flint users of the Ice Age."

Eiseley regards it as a real possibility that our technological civilization will not last much longer and that our cities

will eventually be buried in sand or swallowed by forests. In the past, the common response to such a threat has been flight, but there is no longer any vacant place on earth where to go, and mass escape into space is impossible. Man is in a "cosmic prison" because he cannot survive anywhere in the universe except by transporting with him from the earth the environment he needs for sustenance. "Only on earth does life's green engine fuel the oxygen-devouring brain."

The only solution is that man, the creator of culture, preserve and reenter the world of nature which he needs to retain his sanity. Although he is now intoxicated with his power as a technological magician, he is still under the spell of the "green enchantment" that has been laid on him since the beginning of time.

Ancient history justifies the hope that mankind can change its ways. After the building of the great Neolithic cities and empires, more than 2,000 years ago, "an intellectual transformation descended upon the whole world, a time of questioning." In the ancient Chinese, Indian, Greek and Judaic civilizations, seers and prophets proclaimed that wealth and power were less important than the quality of the inner world. This teaching, which gave rise to the great axial religions, was expressed in different ways by men as diverse as Christ, Buddha and Confucius who by some mysterious coincidence appeared on the earth scene during approximately the same phase in man's history.

"The axial religions had sought to persuade man to transcend his own nature; they had pictured to him limitless perspectives of self-mastery." In contrast, science has recently opened "the prospect of limitless power over external nature." Science seems to be involved in the construction of a structure as ambitious as the Great Pyramid of Giza, though an invisible pyramid. But our planet may not "long sustain this tottering pyramid thrust upward from what had once been the soil of a consumed forest."

The haunting quality of *The Invisible Pyramid* comes in part from its style which has "an unusual evocative hold upon our senses," but even more from Eiseley's mixture of doubt and self-confidence: "I am an anachronism, a child of the dying light. . . . I know only that I speak from the timeless country revisited, from the cold of vast tundras and the original dispersals." The truth is, however, that Loren Eiseley is not an anachronism. He was one of the very first scientists to proclaim publicly that mankind must reinsert itself into nature. His words created a new kind of poetical literature based on objective scientific knowledge and his warning helped start a new social movement.

As the seers of the axial religions did 2,000 years ago, he is teaching our generation to recapture that cosmic sense which is unique to man. He may often appear discouraged, skeptical, and even anti-modern, but this is the inescapable fate of the true poet who, in his words, "is born wary and is frequently in retreat because he is a protector of the human spirit."

Below are extracts from Dr. Eiseley's explanatory preface:

Man would not be man if his dreams did not exceed his grasp. If, in this book, I choose to act in the ambivalent character of pessimist and optimist, it is because mankind itself plays a similar contradictory role upon the stage of life. Like John Donne, man lies in a close prison, yet it is dear to him. Like Donne's, his thoughts at times overleap the sun and pace beyond the body. If I term humanity a slime mold organism it is because our present environment suggests it. If I remember the sunflower forest it is because from its hidden reaches man arose. The green world is his sacred center. In moments of sanity he must still seek refuge there. . . .

In the heart of the city I have heard the wild geese crying on the pathways that lie over a vanished forest. Nature has not changed the force that drives them. Man, too, is a different expression of that natural force. He has fought his way from the sea's depth to Palomar Mountain. He has mastered the plague. Now, in some final Armageddon, he confronts himself.

As a boy I once rolled dice in an empty house, playing against myself. I suppose I was afraid. It was twilight, and I forget who won. I was too young to have known that the old abandoned house in which I played was the universe. I would play for man more fiercely if the years would take me back.

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Highlights

Arts and Industries Building

In addition to the one-pound piece of Apollo 11 moon rock, an Early Bird Satellite—the operational backup model for the world's first commercial communications satellites—is here, as is Neil Armstrong's space suit lunar visor.

"The Hand of Man on America," opening November 10, is a photographic documentary of the man-created objects that have helped to shape our country. The photographs by David Plowden include bridges, railroads and ferries.

"Finnish Design: Tapio Wirkkala" is a collection of nearly 300 objects by this versatile designer in stainless steel, plastic, glass, silver and porcelain.

"Genteel Female," lithographs from the Smithsonian's Harry T. Peters America on Stone Collection, depicts a romantic view of the American woman of the 19th century.

Museum of History and Technology

"Do It the Hard Way," cartoons and inventions by Rube Goldberg (see article page 12), opens November 24.

"Women and Politics" follows the history of women in politics from 1640 to the present, in commemoration of the 50th anniversary of the 19th Amendment.

Two photography shows remaining until November 17 are: "Stephen Whealton," an exhibition of Polacolor prints, slides and other photographic derivations and "Janine Niepce," 40 photographs by this French photojournalist.

The first section of a new Textile Hall is open and features a mid-19th-century Jacquard Loom and demonstrations of spinning and weaving.

Museum of Natural History

"Indian Images" is a show of historic photographs of North American Indians taken from 1847 to 1928.

"Smithsonian Scientists Study the Moon Rocks" includes photographs of the investigation of the contents of the moon-rock specimens.

National Collection of Fine Arts

"The Watercolors of William Henry Holmes" is an exhibition of some 64 delicate, traditional watercolors of Artist Holmes (1864-1933) whose other careers included archaeology, writing and museum directing.

"A Look at the World: Mid-Century," shows 26 American paintings and small sculptures from the NCFA's collection to give an individualistic view of the 1950s. Artists represented include Wyeth, Hopper, Shahn and Rivers.

"Jasper Cropsey" is the first major show ever held of the work of this 19th-century landscapist in the Hudson River School tradition. The show of about 90 paintings and drawings opens November 20.

National Portrait Gallery

"John Quincy Adams" is a major exhibition of 40 portraits from life, including oils, sculptures, miniatures and daguerreotypes, documenting one of the most varied political careers in American history (SMITHSONIAN, October). Associative material from the life of our sixth President will include letters, documents and Adams' desk from the House of Representatives.

"Along This Way," a teaching exhibition on black-culture exponent James Weldon Johnson (1871-1938), uses portraits, photographs and recordings to tell about the man and his work.

Freer Gallery of Art

In addition to its fine collection of Oriental art, the museum's exhibitions include "Whistler's Landscapes and Seascapes" and "Whistler's Etchings," including the copper plates.

Division of Performing Arts

November 1: The Kerala Kalamandalam Company from India—the sacred drama of Kerala.
November 9: Music from Marlboro (chamber music): Mozart, Loeffler and Mendelssohn.
November 14 and 28: Saturday Night Jazz concerts in conjunction with Left Bank Jazz Society.
November 15: Lecture on Contemporary Swiss Music by Rudolf Kelterborn.
November 19, 20: Yvonne Rainer Contemporary Dance Program.
(For further information on time and place of November programs call 202-381-5407.)

Traveling Exhibition Series

Some of the more than 70 Smithsonian exhibits that will appear throughout the country during November are:

Newark, Delaware — "Contemporary American Black Artists" (University of Delaware, opening November 14).
Muskegon, Michigan—"Dutch Art Today" (Hackley Art Gallery, opening November 14).
Knoxville, Tennessee — "Paintings by Carl-Henning Pedersen" (Dulin Gallery of Art, opening October 31).
New Paltz, New York—"Georgian Country Houses" and "Royal Buildings" (Smiley Art Building, State University College).
Los Angeles, California—"The Concerned Photographer" (University Galleries, University of California, opening October 31).
Ames, Iowa—"Photography and the City" (Design Center, Iowa State University of Science and Technology, opening October 31).

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'The only scientific humorist in captivity'

A British columnist, Patrick Ryan, will write for SMITHSONIAN *starting in December*

The author of SMITHSONIAN's new column, Patrick Ryan, has written extensively for *Punch* and Britain's sprightly and respected weekly, *New Scientist.* He has been called "the only scientific humorist in captivity." The column will start in the December issue.

Perhaps surprisingly, Mr. Ryan's full-time work is as head postmaster of Kingston-upon-Thames, a district which serves a large area south of London. He is shown below at Hampton Court Palace, which is part of the district.

Below are excerpts of the editorials he writes anonymously for *New Scientist:*

On sneezing—the highest speed thus far scientifically recorded for the spray of a rhinitic blockbuster is 103.6 m.p.h. This velocity will probably come as no surprise to anyone who, for purposes of chivalry under clandestine beds or espionage behind diplomatic curtains, has ever tried to stifle a nascent sneeze. . . . No amount of eyeball levitation, lip petrifying or nose pressing will do aught but multiply the blast of the eventual explosion.

On blood—to the human mind there is more to blood than its mere chemical content. . . . For example, blood must essentially be thicker than water, impossible to get out of stones, indelible in its staining. . . . When apparent on heads, it should leave them unbowed; and should have the capacities to combine formidably with toil, tears and sweat and to attain boiling-point when its host faces frustration.

On moles—our long period of wet weather was apparently good breeding time for *Talpa Europaea* and their burrowing hordes are now threatening . . . the serene surfaces of golf courses, bowling greens, Kew Gardens, Lords, the Oval and even the hallowed courts of Wimbledon. . . . The mole only operates in good, well-kept soil. . . . He can't live in a poor location because he has to eat about two-thirds of his body-weight every day to keep alive and, if deprived of food for 12 hours, he just dies of galloping starvation. So, the best scientific advice that can here be offered . . . is that [by] maintaining a neglected garden with highly impoverished soil, no mole would ever bother.

On noise—during the [Queen's] Birthday Parade at Plymouth . . . a 21-gun salute . . . brought such volumes of soot cascading down the chimney of Mr. Norman Cunday as to terrify his 92-year-old mother and smother his furniture and carpets. . . . Her Majesty might consider . . . in this Elizabethan age of . . . noise pollution [that such] occasions be celebrated by . . . 101 ten-second repetitions of the blessed sound of silence.

On prophets—Dr. Dionysius Lardner . . . told the British Association in 1838 that "man might as well project a voyage to the Moon as attempt to employ steam navigation across the stormy North Atlantic ocean." Two years later, the Cunard company was offering a regular steam service. None less than Lord Kelvin [offered] his definitive opinion that "I have not the smallest molecule of faith in aerial navigation other than ballooning"—only to find, seven years later, that the unqualified Wright Brothers had flown aloft in their aeroplane. . . . Less than 66 years separated Orville Wright's sandhopping distance of 120 feet from Neil Armstrong's rocketing round trip half-a-million miles to the Moon. A perilous century indeed to be . . . waxing dogmatic about the boundaries of human achievement. Better, perhaps, to leave the use of the emphatic and irrevocable "never" to ravens.

Mr. Ryan's father was Irish, his mother English. He grew up in a Cockney area of London. He went to work for the post office "as soon as I was able and they would have me" and has been there ever since. He began writing short stories with an Irish-Cockney background in the 1950s and later wrote television plays and four books. He was the first man to make a Beatle get a haircut—John Lennon was temporarily shorn for a part in a movie made of his book, *"How I Won the War."* He says the book is based on exaggerated memories of World War II—he was a major in theRoyal Armored Corps, in North Africa, Italy and Greece.

He reports that he does his best to "keep my wife, 21-year-old daughter and imperious dachshund in states to which I can never hope to aspire." His only hobbies, apart from writing, are "cooking, melancholy and depth research into the products of Arthur Guinness and Son, Ltd."

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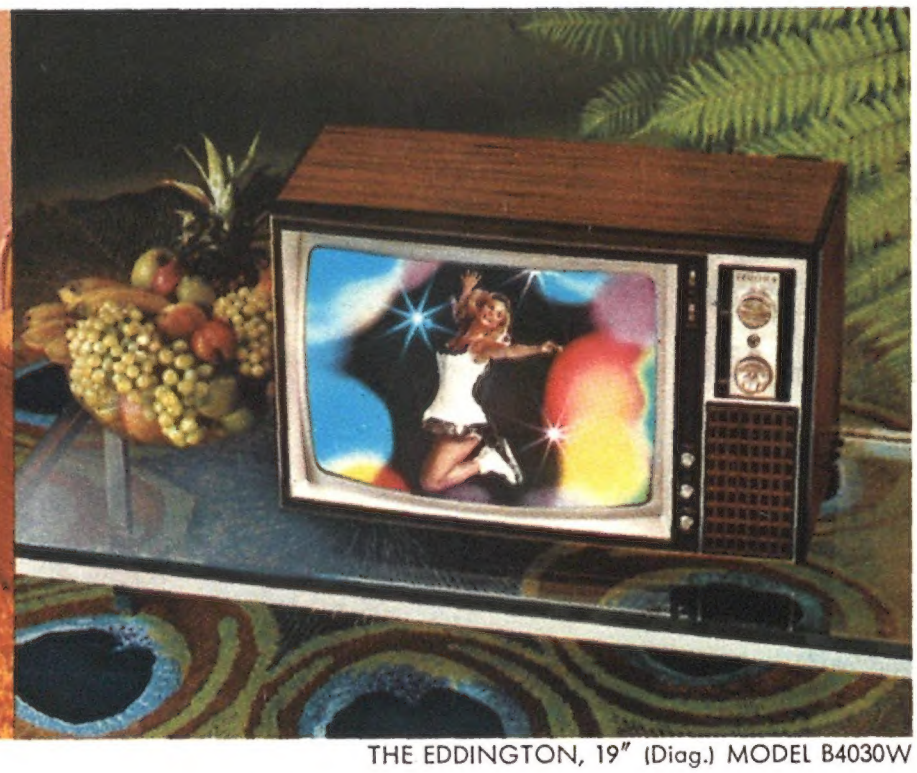

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